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SURGERY, GYNECOLOGY AND OBSTETRICS

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NUMBER 1

THE OPERATIVE INDICATIONS IN HOUR-GLASS STOMACH

WITH A REPORT OF SEVENTEEN CASES¹

By WILLIAM A. DOWNS M.D. F.A.C.S. NEW YORK

THE observations set forth in this paper are based upon the operative results obtained in seventeen personal cases of hour glass contraction of the stomach following benign ulcer. I realize fully that this number of cases is far too small to justify positive statements but the fact that fifteen of them have been observed for an average period of two and one half years after operation and one for more than nine years at least permits an opinion as to the comparative value of the various operative procedures employed. There were sixteen females and one male in this series. The average age was thirty nine years. There was one operative death the seventeenth case dying from pneumonia on the sixth day after mediogastric resection.

Before the roentgen ray came into general use as an aid to the diagnosis of stomach lesions hour glass contraction was considered to be somewhat of a novelty and was usually discovered after the abdomen had been opened. The various means at our disposal prior to the advent of the bismuth meal such as distending the pouches with gases lavage etc. occasionally suggested such a deformity of the stomach but a positive diagnosis could rarely be made. Well taken roentgenograms not only establish the diagnosis at once but give a fairly accurate idea as to the relative size and shape

of the pouches the width of the channel connecting them and the condition of the pylorus. This information gained beforehand is of great assistance to the surgeon in determining the operative procedure best suited to a given case.

The one absolute requirement of any operation employed in the treatment of hour glass contraction is that the symptoms due to obstruction be relieved. If at the same time the procedure adopted can include excision of the ulcer or the cicatrix of a healed ulcer without too great a risk so much the better but the fact must not be lost sight of that the great majority of these patients come to us on account of weakness due to inability to take or retain sufficient food. Pain has become an old story with them and in many instances causes little alarm until vomiting and loss of weight appear. A severe hemorrhage was the immediate cause of one of our patients coming to the hospital. This was the only case in which there was bleeding of any consequence.

At least four operative procedures — gastroenterostomy gastroplasty gastrogastrostomy and mediogastric resection or resection in continuity — are available in the treatment of hour glass contraction. To these pylorotomy should be added as the method to be adopted if the constriction is near the pylorus thus forming a small distal

pouch. We have had no case of simple stricture in which the latter operation seemed to be indicated, and for this reason are not in a position to discuss its merit.

Gastroenterostomy is the operation most generally used for the relief of this condition. The procedure alone was employed in six of our cases and was combined with gastroplasty in a seventh. It is hardly necessary to state that as a rule the intestine should be anastomosed to the cardiac pouch. As an exception Case 11 is cited. In this instance the constriction occupied the middle third of the stomach and we caused it a large extent by perigastric adhesion. There was marked infiltration of the wall of both pouches, proved subsequently to be aphilitic, with a large retention in the lower pouch and no retention in the upper. After the channel connecting the pouches had been sufficiently freed to admit three fingers, the gastroenterostomy was made to the pyloric pouch. The after history of this patient is interesting in that when he died one and one-half year later a generalized aphilitic all symptoms referable to the stomach had been entirely relieved.

Future treatment is at the pylorus in one case necessitated a second operation to relieve it in the pyloric pouch. With this exception the results following gastroenterostomy have been satisfactory in every way. The operation is indicated in the cases in which the constricted area is of wide extent and in those where adhesion prevent mobilization of both pouches.

Gastroplasty has a limited field in the treatment of hourglass contraction due to the fact that it is suitable only for cases in which the pouches are movable, their walls free from induration and the constricted area narrow. It is simple easily to perform and permit direct inspection of the interior of the stomach thus affording an opportunity for treating an active ulcer by excision or caustic application. It may be combined with pyloroplasty or gastroenterostomy if the pylorus is stenosed. Four of our cases were operated upon by this method. In one the cautery was applied to the ulcer and gastroenterostomy added. In two the ulcer was

excised and in the fourth gastroplasty was combined with pyloroplasty after simple gastroenterostomy had proved unsatisfactory. It is interesting to note that at the second operation on this patient the stomach wall which had been indurated at the first had become soft and pliable so that the plastic operation was done with great ease. The end result in this group of cases have been most satisfactory although in one the hourglass deformity to a certain extent persists to the present time three and one-half years after operation.

Gastrogastrostomy is especially adapted to the case in which the stomach is adherent along its lesser curvature to the liver in which the pouches are relatively large, nearly equal in size and can be approximated at their dependent portions. The stomach wall should be free from induration at the site selected for the anastomosis. The pylorus must be patent otherwise pyloroplasty or gastroenterostomy will have to be added. Gastrogastrostomy was performed in three cases of this type with complete clinical recovery in each instance. One of the patients has been followed for nearly nine years.

Midgastric resection or resection in continuity is the ideal operation for hourglass deformity of the stomach provided the pylorus is not tenosed and should be performed in all suitable cases. The ulcerated area active or quiescent as well as the constricted portion of the stomach wall is removed by this method. The end result obtained demonstrates the value of this procedure. Unfortunately it is limited to the case with few adhesions in which the pouches are fairly large and permit of free mobilization. It is a longer and somewhat more difficult operation to perform than the one already mentioned and for this reason if the patient is in poor condition should not be given preference over them. In order to overcome the tendency for the constriction to persist after resection in continuity a wide excision should be made. The roentgenogram of one of our cases taken subsequent to operation illustrates the necessity of bearing this point in mind. Midgastric resection

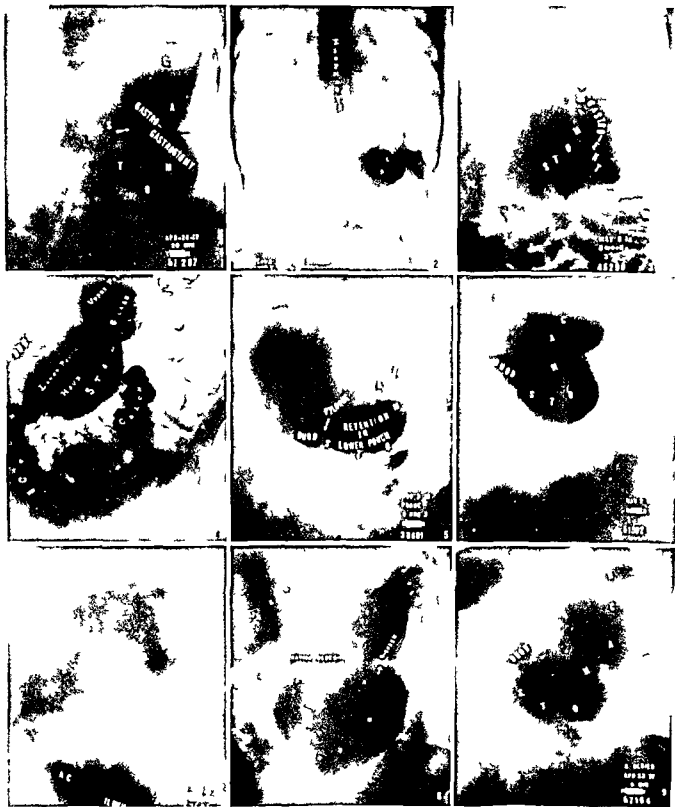
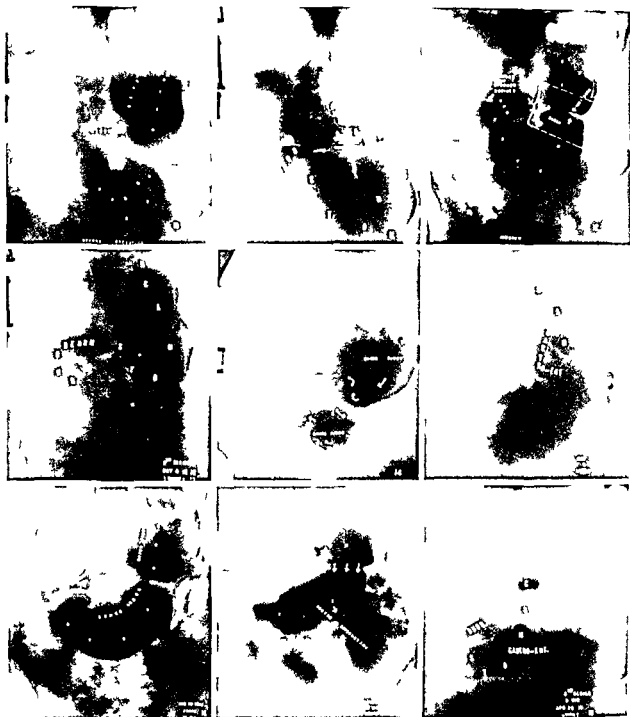


Fig. 1 Case 1 N T Nine years after gastro-astro
tomy for hour gla contraction
Fig. 2 Case 1 H D H ur glass stomach luetic
Fig. 3 Case 1 H D three year after gastro-enteros
tomy for h ur gla stomach
Fig. 4 Case 3 R B Hour glass stomach
Fig. 5 Case 3 R B Two years after gastro-
enterotomy Recurrence of symptoms due to retention
in lower pouch

Fig. 6 Case 3 R B One and one half years after
gastroplasty and pyloroplasty
Fig. 7 Case 3 R B One and one half years after
gastroplasty and pyloroplasty Stomach empty
Fig. 8 Case 4 G M Hour glass stomach due to
ulcer of lesser curvature
Fig. 9 G M Three and one half years after ex
cision of ulcer and gastropyloroplasty Persistence of de
formity Symptom free



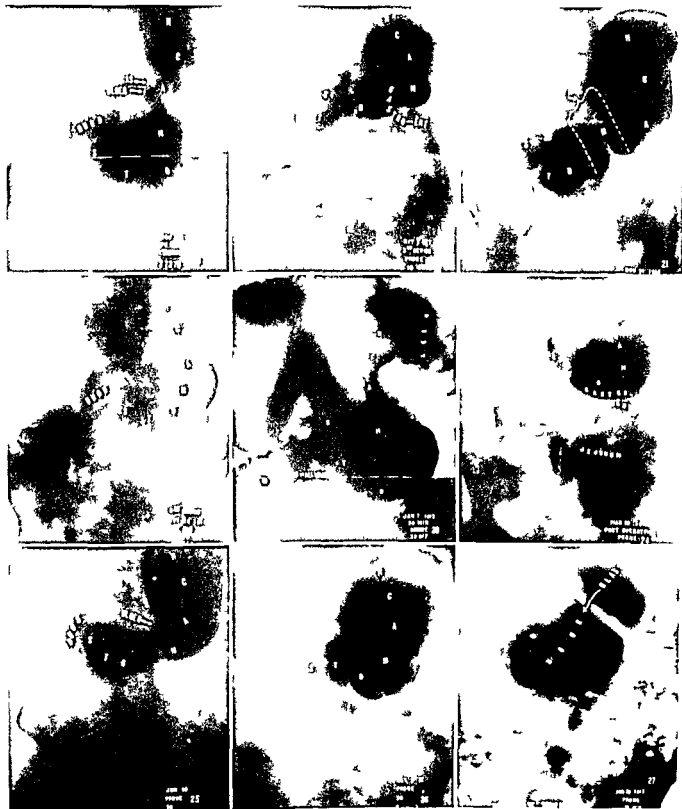
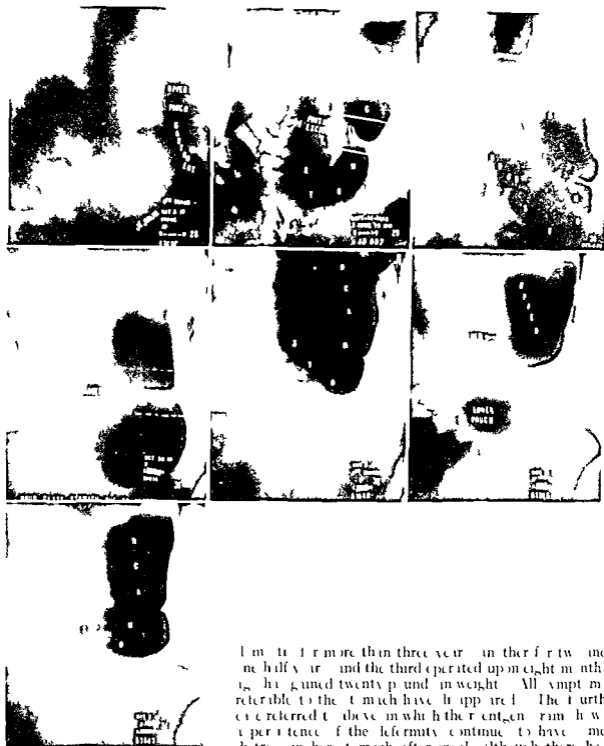


Fig. 19 C s 9 I C I n t a t i n g u l c r o f s t m c h
 Fig. 20 C a 9 I C T o o and one h l f year fter
 gastro ente stomy
 Fig. 21 Case 10 I I H o r g l s stomach
 Fig. 22 C a e o L I T o y e r after m l i o
 b a t r i c c t i n
 Fig. 23 C e 11 C I H o u r g l a s s t o m a c h l u e t i c

Fig. 24 C e 11 G R T o m n t h s after gastro-
 enter stomy
 11^o C a e 2 N O H H u r g l a s s t o m a c h
 l e r a t l e s s r c u r v a t u r e
 11^o 6 C a 12 N O H T o y e a r s after gastro-
 p l s t y w i t h e c c i o n o f u l c e r
 1^o 2 C s 13 M O H o u r g l s t o m a c h



with the method adopted in five cases. In three a perfect result seems to have been obtained, one has worked continuously since

the first more than three years, in the first two and one half years, and the third operated upon eight months ago has gained twenty pounds in weight. All symptoms referable to the tumor have disappeared. The fourth case referred to above in which the retroversion has been experienced since the deformity continues to have no effect in her stomach after meal although there has been no vomiting. She has gained in weight and has continued her work. The fifth case died of pneumonia on the sixth day after operation. The patient was not in good condition and a less severe operation should have been performed.

SYNOPSIS OF SEVENTEEN CASES OF HOUR GLASS STOMACH

C N m d	S Ag	Ho p t l	H t r y	Op t l p t	I t c l t
N T	I 35	M m l	P f t g g t r l J l y l f p m t h f p t t h m t h	C t a t t m y N m b 9 8	E l l t l f r m t m h y m p t m
H D	F 4	St L k	P t J m t g f t y l W m m f p l	P t g t e t t m y t d p o h J l y 9 3	V r y g l N p m t
3 R B	F 5	St L k	y m p t m f t m h t b l f t h t y y	P t g t t t m y t l p h S p t m l 0 3 R t f y m p t m l t t p l p o h G t N t y t h J l r p l t y m b 9 5	S t f t r y N p m t m t a l g m t f g t t f p b l y l t f l h
4 G M	I 34	St L k	I d t f m y y m t a t t p t f k g f	C t p l t y t h f l O t b 9 3	Good N m t g t f D e f m t y f t
5 D N	F 45	t L k	L g t l g h t r y Sympt m k t f p t	C t t t m y J r y 9 4	V r y g d N p m t g l t h h N y h w t t b l
6 A S	F 8	St L k	A m t l p f y	M l t t l l r y 9 4	F l l t
7 A W	F 5	St I k	P m y l m t g f	P s t l g t e t t m y t J p o h 9 4	C o o l F f m y m p t m
8 S W	I	t L k	g f f m l m t	C t l l t y t t f t g t o t t m y t S p t m b 9 4	V r y g l Sympt m t l y l l
9 I C	I 3	St I k	f f f y k m	I t g t t t m y t N m l p o h 9 4	F l l t Sympt m t l y t l
E L	I	St L k	P t l m t g f t h t y f g	M l t t N m b e 9 4	V r y g l
(R	I 34	t L k	E p g t p l f t m t m f p l W m t	I t t f l h t t m y t J l p o h t J l r y 9 5	D l l f t p e t h l f y g l t f p e t y p h l R l t f p e t t f t r y
N O H	I	St I k	f y l t t g f C t m t h	C t l l t y t h f J 9 5	S t f t l Sympt m N t t f
3 M O	M 5	St L k	P t m h f t h f m p t m g	C t t t m y t l p o h r y 9 6	C l l f m t m h y m p t m
4 A E	I	t I k	I l m t f	M l t t f m b e 9 6	M o d p f t m l p m t N y l w f l f m t y
5 A G	I	St L k	y s l t f y m p t m	M l g m b e N m b e 9 6	F l l t
6 K H	I 53	St I k	y m p t m f m y s r s l t t m t I t f t h	C t t t m y D m l 9	V r y g o d
7 H C	F 3	St L k	I t t f m y h t h e e k b e f l m	M e l g t e s e c t n. M h 7	D e d t h l y f p t m

The fifteen patients of the series surviving to the present time have been examined and checked by roentgenogram during the past few weeks. All have gained in weight and with the one exception are practically free from the symptom for which they sought relief.

The roentgenogram taken at a considerable period of time after operation demonstrates very clearly that the virgula method employed here met the prime indication that is overcome by the obstruction. Whether the results obtained will be permanent in every case remains to be seen but certainly some

of each group have been followed sufficiently long to warrant the claim that a cure has been effected. From a study of the clinical result I have come to the conclusion that each of the four operative procedures above mentioned give equally good results provided the correct one is applied in a given case and is executed in a proper manner.

I take this occasion to express my obligation to Dr F. L. LeWald, radiologist to St. Luke Hospital through whose assistance and co-operation this report has been made possible.

THE TREATMENT OF WAR WOUNDS

A DISCUSSION OF THE ANTISEPTIC AND OPEN AIR TREATMENT COMPARED WITH THE ANTISEPTIC TREATMENT

BY COL. HENRY H. HARRIS, U. S. ARMY, MEDICAL COLLEGE, UNIVERSITY OF CHICAGO, CHICAGO, ILL.

Indicating such a brief question as the treatment of war wounds, one must start with the premise that the whole subject relating to the therapy applied to the care of wounds must be regarded as an art and not a science. The deductions that are drawn regarding the value of any given method of treatment are therefore largely upon clinical observation and to a smaller degree determined by accurate and scientific facts.

It must be admitted in all fairness that the element of personal bias and prejudice enter as a prominent factor in all conclusions regarding the value of this or that method. Those of us who passed through the era of antiseptic treatment of wounds employed over twenty years ago when every wound surface and infected cavity was irrigated with every known drug with real or supposed antiseptic property were rather startled when we began to read of a return to this practice as applied to war surgery and may I add many of us were skeptical.

Since I have come into the field of War Surgery and have been obliged to treat hun-

dred of the large infected wound I have tried as far as possible to maintain an open mind toward the antiseptic method of wound treatment and I have attempted to give the antiseptic treatment a fair trial. The attempt to apply in the main the Carrel Dakin treatment and the use of a 5 per cent preparation composed of 50 per cent iodine form 5 per cent liquid pyridine. The second method is the one most frequently used in the British Army Medical Service.

We may safely assume that practically every one of the war inflicted wound—large or small—is potentially if not actually infected.

This is particularly true if the missile has passed into part protected by clothing. It was one of our early observations that nearly every one of our seriously infected wounds contained part of clothing and extraneous matter as well as the missile. In fact we are coming to regard the seriousness of the infection as directly dependent upon and proportionate to first the amount of circulation destroyed and second the amount and

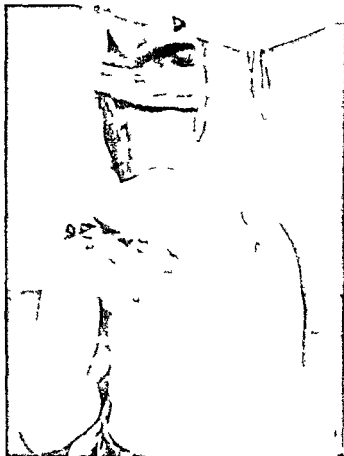


Fig. 1. Large wound of skull and capula treated by open air method. Scapula closed. Cranium surface clean and healthy.



Fig. 2. Large deep wound of leg, and thigh. Knee joint not opened. Treated by open air method. Granulation surface healthy. Epithelium spreading rapidly from edges.

character of the extraneous foreign material carried into the tissues with the missile.

The wounds inflicted with the smooth shrapnel bullet and with the machine gun or rifle bullet are much less apt to contain clothing and therefore frequently remain clean when infected they do not show such severe tissue reaction.

Granting that all war wounds are potentially infected with either aerobic or anaerobic organisms or both our first thought in their treatment should be a consideration of the pathology of the tissue reaction. The organisms introduced may be aptly compared to an invading army capable of multiplying rapidly. Against this invading foe arise the defensive forces of the human organism. Unfortunately in the present stage of our knowledge we are unable to state scientifically the exact nature of these defensive agents.

Grossly speaking they are the antibodies and the phagocytes brought to the part by

the blood stream and possibly produced by the fixed cells. Any logical method of wound treatment must have as a basis first the maintaining and strengthening of the defensive forces and second the destruction or removal of the invading organisms.

This may be a simple and obvious statement and yet when analyzed it is a most difficult problem to solve practically. The first query that arises appears to me to be this important question: Is there any known antiseptic solution that can be applied to living tissue which will destroy bacteria deep in the lymphatic spaces without materially lowering the resistance of the tissue?

My conviction is that at the present time there is no such germicide known to the surgical profession.

The all important factor to consider is—how far must one go in attempting to destroy the bacteria and how much must one promote the maintenance of the resisting power of the cell? It is true to say that the bacteria on the surface of a granulating wound do little or no harm unless one contemplates doing a secondary closure. It is the organisms deep in the lymphatic spaces that produce the tissue destruction.

As my experience in war surgery grows I become more and more impressed with the importance of the maintenance of the nutrition of the cell as being the most essential factor in increasing its resistance. This nutrition is largely dependent upon blood



Fig. 3. Diagram showing the distribution of blood supply to the tissue in the proximity and second by promoting the absorption and distribution of toxin. In on the surface the little r no harm to the general organism.

supply. It is under pressure of it diminish first by shutting off the blood supply to the tissue in the proximity and second by promoting the absorption and distribution of toxin. In on the surface the little r no harm to the general organism.

One of the most important and central element in the treatment of the fresh wound is the time element. This is a principle in surgery that has been long recognized and is being again demonstrated most forcibly in practical war surgery.

The recognition of this principle has resulted in an organization of the medical departments of great armies to meet this situation. This is particularly true in the French Army where every effort is made to get the badly wounded man to a place where he can receive adequate attention in the shortest possible time.

Efforts have been made to ascertain accurately and scientifically the phenomena of war wound. This can be best illustrated in the most virulent and rapid infection taking the gas bacillus as a type. This work has been done and described by Fildes and Philip in their study of the early infection of wounds and was quoted by Judd in *SUGGLY GYNICOLOGY AND OBSTETRICS* for September 1917.

Their conclusion are stated as follows:

1. Up to the fifth hour after the receipt of the wound no reaction manifests itself. Microscopic examination shows the presence of blood clots enclosing fibers of cloth debris of the surrounding tissues, connective tissue

fiber torn nuclei more or less altered muscular fiber traumatized but no infiltration of leucocyte.

2. From the fifth to the ninth hour commence the reaction of the tissues. Migrating elements appear and polymuclear neutrophils, large mononuclear and small lymphocytes are found. The reaction of healthy tissue is feeble but at the same time the traumatized tissue shows signs of degeneration.

3. From the ninth to the twelfth hour approximately the appearance of the bacteria is noted. Large club shaped organisms, gram positive, club shaped bacilli, *perfringens* or bacilli *aerogenes capulatus*. The bacilli appear first in the immediate neighborhood of the cloth fiber and grow in the blood clots which enclose them.

4. After about the twelfth hour three phenomena dependent upon the three are evolved simultaneously.

a. The bacilli multiply and spread out farther from the cloth fiber.

b. There is a production of polymuclear neutrophils which a small number perform the function of phagocytosis. The reaction of defense of the tissue is clearly insufficient.

c. The leucocytes are altered and are transformed by degeneration into glial cells. It is but a temporary phenomenon of leucocyte limit of the production of leucocytes.

5. The phenomena continue slowly at first but are accelerated from the twentieth to the thirty-sixth hour at which time the production of leucocytes is almost always at the forty-eighth hour the infection is associated with necrotic organisms which favor their development by absorbing the oxygen of the medium in which they are growing.

This work has been carefully and thoroughly done but obviously the deduction are only relatively accurate for the time that organisms may appear in tissue or the tissues show a reaction is largely dependent upon the nature of the wound, the virulence of the organism, the number introduced and the resistance of the tissue which varies with the amount of nutritional disturbance produced by the trauma.

However it can be stated with reasonable

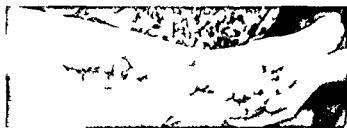


Fig 4 Large wound of leg and foot with massive destruction of superficial and deep tissues. Bone of foot exposed. This was treated with open air method with ut dress in of any kind and filled rapidly with granulations which covered over the exposed bone



Fig 5 Deep wound of upper arm with fractured humerus treated without dressing or irrigation responding most favorably

certainly that the sooner a wound can be adequately treated the less is the tissue reaction that will ensue

So far as possible all wounds should receive surgical attention within the first few hours. If it is practical to accomplish this a very large percentage of all wounds will remain clean and if properly treated will unite by primary union.

It has been shown that the small wounds with a punctuate wound of entrance and a small wound of exit may very properly be treated with a dry dressing and not disturbed and in a large proportion of the cases there will be little or no tissue reaction that will require further treatment. In the large wounds inflicted by an irregular missile where the edges are contused or lacerated to a greater or less degree the subject is not so simple.

As I view it all of the latter wounds should be treated by an early and thorough excision of all ragged or detached bits of tissue that have come in contact with and been soiled by foreign materials. This statement has reference to skin subcutaneous tissue and bone when the missile has actually pierced it. Obviously the missile and all other foreign material should be removed.

It is customary to apply to such wounds a 4 per cent or 5 per cent solution of iodine. I am not convinced that this latter is essential.

The all important principle is to excise all tissue the nutrition of which is questionable and all tissue which has been contaminated by the foreign material. This excision must be done with good surgical judgment and discrimination. It is surprising how resistant the large blood vessels and nerve trunks are

and how frequently they are pushed aside without damage. In this event they need not be disturbed. As soon as the wound has been thoroughly treated by excision of all contaminated tissues it can be sutured and a very large percentage of them will heal by first intention.

This latter broad statement should be modified in the case of deep wounds of the thigh as it is believed that it is better to insert sutures at the time of primary excision and tie them within forty eight hours if there be no reaction.

I do not hesitate to express myself very strongly as opposed to the packing of these freshly infected wounds with gauze. In exceptional cases soft rubber tissue may perhaps be used to advantage.

The so called b i p in my opinion is of no value in preventing infection in a wound and is detrimental from all other viewpoints. From an analysis made by Lieutenant Gispel of one hundred cases which came to us having been treated with b i p the following statistics were gathered. 8 per cent showed distinct evidence of bismuth poisoning as manifested by the blue line on the gums stomatitis and constitutional disturbances. 19 per cent had an acute hemorrhagic nephritis with large quantities of albumin casts and red blood cells in the urine. In some of the cases the blue line persisted for many weeks. The dangers of this treatment are self evident.

In considering the question of the treatment of the extensive older infected wounds with widespread tissue reaction and marked constitutional disturbances we must recognize that we are dealing with a condition entirely different a distinctive pathological entity.

In applying treatment to this class of case the first and essential element is competent

and adequate drainage. This drainage must be established without regard to the science of superficial tissue. Skin, subcutaneous tissue and deep fascia must be incised longitudinally or horizontally in a manner which will prevent pocketing, muscles must be separated and cut completely across if necessary to secure a wide open wound. All foreign material should be removed, but I believe that little excision of the surrounding borders should be practiced in these wounds, for I feel that Nature has thrown up a barrier in the surrounding tissue which had better not be disturbed during the time in which we are attempting to secure perfect drainage. Any tissue clearly necrotic should be removed.

Again I think it is important to avoid as far as possible the insertion of any tubes, gauze, rubber tissue or other form of drainage material. The best drainage can be secured by a free incision into all cavities containing pus, those incision being made so as to prevent further pocketing.

It will naturally occur to the reader that occasionally it will be necessary in the preservation of a flap to place some foreign material beneath that portion of tissue which is left to prevent its becoming adherent immediately to the deeper structure. In this event rubber tissue or paraffin gauze is the preferable material.

After a wound is completely drained I doubt if irrigating solutions are of any value either mechanically or because of germicidal qualities. I do believe that hot baths and hot moist dressings are an advantage, for they tend to promote better nutrition of the part by bringing to it a greater blood supply, thereby aiding the natural defenses of the body.

It is our practice first to secure adequate drainage in these large badly inflamed wounds as stated above. Then during the first twenty four hours we resort to hot packs or hot baths. After this the wound is exposed to the open air with no dressing

whatever in contact with its surface for at least twenty hours out of the twenty four. During two periods of two hours each within the twenty four hours the wound is covered with hot moist dressing or immersed in a hot bath.

It can be understood readily that the wound must be protected from flies by means of a screen and preferably should be kept warm with an electric light beneath the screen if that be available.

We are now confronted with the problem of applying measures to close the wound by secondary suture for the purpose of shortening convalescence. I believe that it is in this relation that the Carrel-Dakin solution probably plays an important role, for I think we must admit that if the solution is properly applied with great attention to detail we can cure a granulating surface that is free from bacterial infection. The bacteria which have existed in the deeper lymphatic space are destroyed by natural agents or eliminated at the surface by exuding serum. A secondary measure and culture how in a septic surface many of the wound can be secured in a given proportion of them will heal by first intention. Naturally such a result to be desired and materially hastens convalescence. If one is not contemplating the secondary suture of such large wound I doubt if my antiseptic solution materially hastens the granulating process.

It is unfortunate that it is impossible for all hospitals in the War Zone to have the facilities and personnel with which to apply the Carrel-Dakin treatment safely and effectively. It is recognized that the method is not free from danger if misapplied.

In those wounds in which secondary suture is not contemplated I am sure that the open air septic method gives more comfort to the patient, a more rapid process of granulation and much less constitutional disturbance than any other method that is being employed at the present time.

A NEW METHOD FOR THE PRODUCTION AND TRANSPLANTATION OF DOUBLE FACED AND COMBINED FLAPS

WITH REPORT OF A CASE

By NELSON AMOS LUDINGTON M.D. NEW HAVEN, CONNECTICUT

IT is purpo ed to et forth the technique and principle of a new procedure in which the finger is employed and by which the operator can procure and tran plant from one part of the body to another (a) a simple skin flap pre enting an epithelial surface on one side only (b) a double faced flap of kin and tissue pre senting an epithelial surface on both sides (c) a combined flap which is in part double faced and in part simple or single faced

Fortunately the necessity for the trans plantation of doubled faced flaps is not of so frequent occurrence as for the transplantation of single faced or simple flaps but when it does occur it is of far greater importance

The finger is utilized both in the production and transplantation of the double faced flap as well as in the production and trans plantation of the combined flap In each of the e in tances the finger is incorporated into and becomes a part of the flap In the case of tran plantation of single faced or simple flap however the finger appears solely in the role of a temporary host being concerned in the *transplantation alone* and not in the production of the flap

As the particular technique to be followed in any given case is directly dependent upon the specific requirements of that case and as the general principles governing the production of the flap required are dependent upon the successful maintenance of nutrition in the flap and vary in the different character of flaps mentioned it is necessary to distribute the description of the technique under several heads

The general procedure consists of splitting the dorsum of the finger and spreading its integument out laterally so as to form a flat surface The finger is then implanted into a tunnel prepared in the abdominal wall in

such a way as to bring the raw surface of the finger flap into apposition with the raw under surface of the raised abdominal skin and suturing the two together In this manner a double faced flap is produced which by a later operation is transplanted to the site of the defect to be repaired when by a still later operation the finger is released by amputation

The use of the finger either as a temporary host to the abdominal integument or as a permanent part of the transplant affords an

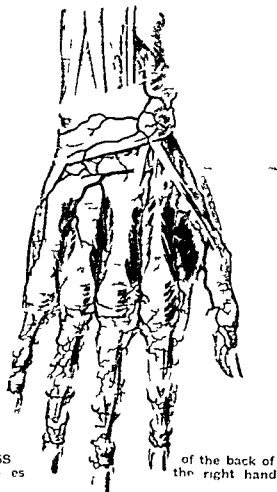


Fig 1 Drawn showing the arteries of the back of the right hand (from Spalteholz)



FIGURE 1. Results of the procedure.

excellent method of obtaining either a single faced flap, a double faced flap, or a combination of both single and double faced flap, either with or without the support of the pharynx. The procedure to be adopted in any given instance must be determined by the requirements of the case in question.

For the purpose of considering the principle involved in the autotransplantation of flap, the requirements of different cases may be grouped into two general classes: (1) low.

First. The cases in which the area of the abdominal skin flap is to be not greatly in excess of the area of the finger flap.

Second. The cases in which the area of the abdominal skin flap is to be very considerably in excess of the area of the finger flap.

CLASS I

In this group of cases it will ordinarily be necessary to transplant a two faced flap, i.e., a flap presenting on both sides an epithelial surface for the reason that the more usual and less complicated plastic procedure in general use affords simple and efficient means for the repair of the vast majority of cutaneous defects where only one cutaneous surface is required and when this surface is not larger in area than the finger flap obtainable by the method.

The procedure is accomplished in three distinct stages which are hereafter referred to as the first, second, and third stage of the operation and should not be confused with the various phases of the circulatory cycle of the flap to be hereafter described.

The first stage of the operation or the implantation consists of the production of union between the finger flap and the abdominal integument.

The second stage or transplantation consists of the releasing from the abdominal wall of the double faced flap so procured and its transfer and suture to the defect to be repaired.

The third stage or amputation consists of the amputation of the finger and the



FIGURE 2. Results of the procedure. (Left) Preoperative view. (Right) Postoperative view.

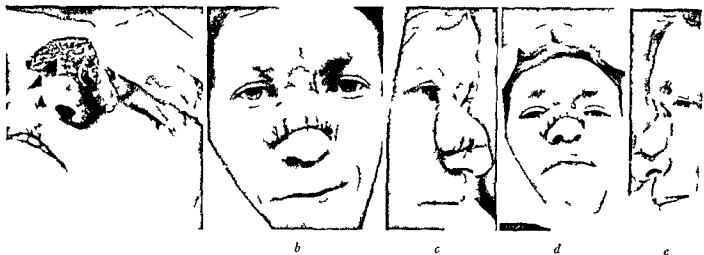


Fig. 4. a View showing palmar skin of finger acting as lining to nose and granulation on raw surface of retained tip of nose. Note body and thickness of flap.

b Shortly after operation. Stump of the flap sutured to tip of nose. Dark areas on suture line are carb.

c Lateral view, same as b.

d Showing redundancies flap too thick.

e Same lateral view.

final fitting of the flap into its permanent position.

Rhinoplasty. One of the most obvious occasions for the application of flaps in cases belonging in the first class is found in rhinoplasty. By the application of this double faced flap not only is the superficial defect remedied but a lining is provided for the nasal cavity and a bony support for the tissues transplanted.

The ring finger of the left hand is selected as being the one most easily dispensed with and is entraining the minimum of functional disturbance in the hand as a result of its loss.

In women there generally need be no preliminary preparation of the finger. In men however the hair present on the dorsum of the finger may require permanent removal either by electrolysis or X rays in order that the finger shall become eligible to occupy its new position. In the repair of ectopic vesicles for instance the removal of these hairs is necessary in order to avoid phosphatic incrustations when the finger skin shall have become the interior wall of the bladder.

Strict attention should be paid to the care and preparation of the nail removing therefrom all foreign material and securing the most complete aseptic conditions possible.

The site selected for the implantation into the abdominal wall in the absence of some special contra indication should be upon the

right side of the body in such a situation as will permit the hand and forearm to rest in the most comfortable position while union is progressing in the apposed flaps. This situation will usually be high up in the right iliac region so as to bring the forearm across the abdomen at approximately a right angle and the lower border of the hand just above the umbilicus.

The first finger incision is made in the midline of the dorsum of the finger from the base of the proximal phalanx to the root of the nail (Fig. 7). This incision is carried down to the extensor tendons overlying the bone.

A second incision is made commencing at the proximal extremity of the first incision and extending forward and laterally across the dorsal aspect of the finger and its web on either side and terminating at the junction of the web with the skin of the palm of the hand (see Fig. 7). This incision also is carried down to the extensor tendons in the median portion of its extent. Both dorsal digital arteries and the nerves to the finger are deliberately divided. The division of the arteries is unavoidable in the division of the nerves and by dividing the nerves the patient is saved that pain in the finger which otherwise proves to be a troublesome complaint during the sojourn of the finger in the abdominal tunnel.



The loss of blood supply resulting from the division of the dorsal digital arteries is quite negligible because of their small size and the very limited area of finger tissue which they supply.

A third incision (Fig. 7) oval in shape is made around the tip of the finger removing the nail and its matrix. Great pain should be taken to remove all of the root of the nail but some small sliver of ungual tissue perist and give rise to trouble by its growth later on.



Fig. 6. Illustration of the finger showing the incision made around the tip of the finger to remove the nail and its matrix.

All the soft tissue of the finger with the exception of the tendons are then to be reflected from either side of the bone and are to be spread out laterally to form the finger flap. The dissection should be carried around considerably more than one half the circumference of the phalanx in order to permit of the greatest possible extension of the flap. Care should be exercised during this dissection to adhere so closely as possible to the extensor tendons so as to lift in the flap all the branches of the palmar digital arteries which will be plain by referring to Figure 1 supply not only the palmar surface of the finger but the lateral and dorsal tissues as well from the tip of the finger to a point just above the proximal interphalangeal joint. By these arteries we have nutrition carried directly to the edge of the finger flap which are most remote from its pedicle of palmar skin. It was to take the fullest advantage of this anatomical fact that this type of finger flap was designed.

As this is accomplished the flexor tendons come into view in the depth of the field and are divided as near to the tip of the finger as possible. The hand is then supinated and a short longitudinal incision made in the palm exposing the flexor tendons over the

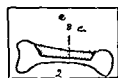


Fig. 7 Diagram showing the incision made on finger
A Mesial dorsal incision BB incision ventral incision
racquet incision

Fig. 8 insert Fig. 7 Lateral view of proximal phalanx
diagrammatic showing saw cut at A B and C The
shaded portion is to be removed

base of the metacarpal bone. Through this incision the tendons are hooked out with drawn from their sheaths in the finger and divided as high up as is convenient the cut ends being allowed to retract into the palm.

By this procedure two advantages are gained first all power to disturb the flap during the progress of union by efforts at flexion on the part of the patient is eliminated second in the event of infection the tendon sheaths as a factor in spreading it are removed as they are permitted to collapse and become obliterated. The palmar incision is closed at once and the proximal phalanx prepared for service as the columnella.

Preparation of proximal phalanx to serve as the columnella is done with three saw cuts and for this purpose a thin septum saw is required.

The first saw cut is made transversely to the long axis of the bone as near to the base as is consistent with safety to the joint and its ligaments. It is carried through one half the thickness of the shaft of the bone and is inclined at an angle or beveled away from the base of the bone (Fig. 8 insert Fig. 7).

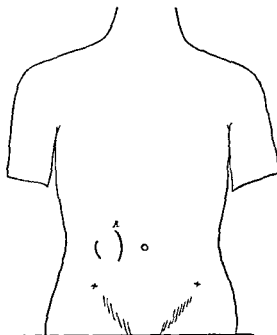


Fig. 9 Diagram showing shape and location of skin
incision in abdomen for implantation of finger a First
incision convex toward umbilicus b second incision con-
vex toward flank

The second saw cut is similarly placed as near to the head of the proximal phalanx as possible and is also carried through one half of the thickness of the shaft of the bone and inclined at an angle or beveled away from the head of the bone and toward the first saw cut.

The third saw cut connects these two and should traverse the middle of the shaft of the bone from side to side. When this third saw cut is completed the dorsal half of the shaft has been cut away and together with the extensor tendons attached thereto is removed and discarded.

The object of this procedure is to obtain as thin a structure as possible around which to fashion the columnella. The flexion of the finger at the proximal interphalangeal joint when the flap is placed on the face will bring this joint into good position to serve as the tip of the nose.

The finger is now wrapped in hot towels and the abdominal tunnel prepared for its reception.

Preparation of the abdominal tunnel is accomplished by two incisions and the separation of the skin between from the un-

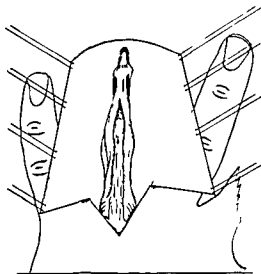


Fig 8. Finger flap distal split lift
tongue

derlying tissues. The first or proximal abdominal incision is made at the site previously selected in a direction at right angle to the long axis of the finger when the hand is laid across the abdomen in the position it is to occupy during the healing of the flap. Its length is slightly in excess of the breadth of the base of the finger flap and it is made with a slight convexity toward the median line to permit of easy suture to the V shaped edge of the skin of the dorsum of the hand (Fig 9).

By blunt dissection the skin only is raised from the fascia and fat from this incision laterally toward the flank for such a distance as is ample to allow the entire finger flap to be introduced. The width of the dissection is determined in like manner.

The finger is then introduced beneath the abdominal skin and the location of the second or distal abdominal incision determined by selecting a point 2 centimeters beyond the tip of the terminal phalanx. Allowance of 2 centimeters is made for the pad at the tip of the finger and for the splitting and freshening of this edge of the flap in the second stage of the operation.

At this point the second abdominal incision is made in its general direction parallel to the first. Its length is determined by the breadth of the distal extremity of the finger

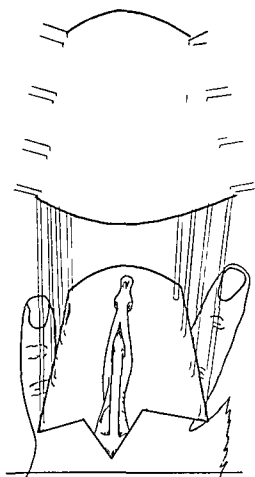


Fig 9. Skin graft to the hand

flap and its convexity is toward the flank or away from the tip of the finger so as to correspond with the shape of the distal end of the finger flap (Fig 9).

The lateral extent of the tunnel so formed should be slightly in excess of the lateral extent of the finger flap as in this manner there is provided opportunity to carry the retaining sutures slightly to one side thus insuring moderate lateral traction on the finger flap. This excess tunnelling also brings about a considerable increase in the blood supply of the areas of skin through which the incisions to release the flap are to be made when union in the apposed flaps is complete.

That portion of the flap which is to lie proximal to the proximal interphalangeal joint should be dissected up with a special care. In the mesial two thirds where it is

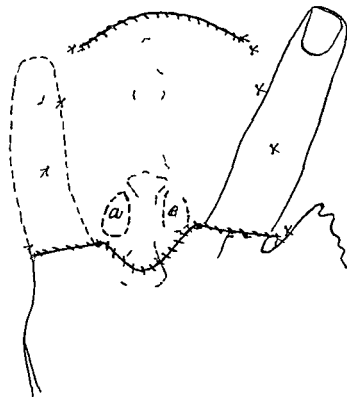


Fig 12 Finger flap introduced into abdominal tunnel all sutures tied. Second and little fingers which overlie flap are omitted for sake of simplicity. Areas *a* and *b* indicate location of nares. Dotted lines in areas show incisions in finger flap to be made when nares are fashioned. Phalanges outlined to show relation of nares.

to overlie the thinned phalanx and where the nares are to be formed its thickness should be reduced to the lowest limit compatible with safety.

When the proximal phalanx is flexed to its proper position as the support of the columella the folding of the soft tissues laterally will provide an ample redundancy of tissue from which the alæ may be fashioned. Careful attention to hæmostasis at this point in the procedure is important as the formation of hæmatoma would seriously affect the contour of the flap and to await its resorption would materially delay the progress of the case.

Six or eight sutures of silkworm gut are used to secure the finger flap in position in the abdominal tunnel and these are passed prior to the introduction of the finger into the tunnel. One is placed in each corner of the finger flap and one or two in each lateral margin. They are entered on the raw surface of the flap close to the edge so as

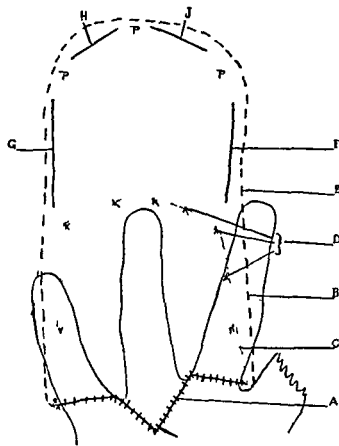


Fig 13 A Suture line of abdominal skin to dorsum of hand and palmar flap. B dash line shows size and shape of abdominal skin undermined. C dotted line indicates edge of spread finger flap. D suture holding finger flap in place in the tunnel. E same as B. F first incision made to force nutrition into apron through amalgamated flap. G, H, and J other incisions in sequence. P, P, P pedicles to prevent retraction.

to transfix the flap emerging on the cutaneous surface they are then re entered on the cutaneous surface transfixing the flap and emerge on the raw surface at a point close to the original point of entry (Fig 10). A line connecting these two points should be parallel to the lateral edge of the flap. The ends are left long clamped and the needle removed. When all of these sutures have been placed their ends are again threaded into the needle and the abdominal skin transfixed from within outward and the ends again secured with clamps. When all the sutures have been passed through the abdominal skin at points which correspond with the points which each suture respectively occupies in the finger flap traction on all these sutures at once draws the finger flap to its proper position in the abdominal tunnel.

The sutures are then tied using just sufficient force in the tying to secure *coaptation* of the flaps *not compression*.

The amount of tissue in the suture when passed through the abdominal skin should correspond with the amount of tissue included by the same suture in its bite in the finger flap.

The proximal and distal edges of the abdominal flap are sutured to the corresponding edge of the finger flap and in the case of the proximal suture line this will include the free cut edge of the skin on the dorsum of the hand as well.

For these sutures either silk worm gut or horsehair are to be used.

When union between the coapted flaps is complete and the edema has entirely disappeared the nares are formed in the thin proximal segment of the coapted flaps by an elliptical incision on either side of the proximal phalanx as indicated by the dashed lines in Fig. 12.

The midpoint of the long axis of the ellipse should be opposite the midpoint of that portion of the shaft of the phalanx from which the dorsal half has been removed. The mesial or inner margin of the ellipse should be within half a centimeter of the lateral border of the bone. The outer margin of the ellipse should be distant from the inner margin one fourth of the distance from the lateral border of the bone to the lateral margin of the finger flap.

The anterior end of the ellipse should be opposite the distal end of the thinned portion of the bone and the posterior extent of the ellipse will be determined by the edge of the flap (Fig. 11).

This elliptical incision is in the abdominal skin flap only. A simple straight incision is made in the finger flap from one end of the ellipse to the other in its long axis. The finger skin is then drawn up through and sutured to the margins of the ellipse (Fig. 12). A firm rubber tube is then inserted into each opening to aid in molding the aperture and to serve as a drain for the nasal cavity when the flap shall have been sutured into its permanent position on the face.

A piece of perforated rubber dam is drawn

through the tunnel and a piece of gauze laid between this and the skin of the finger. The surrounding abdominal skin is liberally powdered to absorb moisture. The forearm is secured in position with adhesive plaster and a binder applied.

The little and middle fingers are allowed to rest on the flap alongside the ring finger and are reinforced with light pressure pads to aid in molding the abdominal skin around the phalanges of the ring finger.

Thus it is seen that the entire nose has been constructed in a flat plane on the abdominal wall and when the second stage of the operation is accomplished the nares are brought into their required position by flexing the proximal interphalangeal joint.

Modifications of technique for other conditions. The above described technique may be considered as the typical procedure for cases belonging in the first class, i.e. where the area of the abdominal skin flap is to be not greatly in excess of the area of the finger flap. There are other conditions however to which the method is equally adaptable such as partial rhinoplasty, cheiloplasty and ectrophy of the bladder but in the conditions certain modifications will be necessary. In order to make clear these modifications in this class of cases as well as the changes in the technique for cases belonging in Class II it is necessary to follow the various circulatory changes or more properly *phases* through which the flaps pass in the three steps of the complete operation. It is upon a consideration of these phases that all modifications of technique are based.

In this first class of cases it will generally be necessary for the reasons previously stated to transplant a double faced flap and the finger is amputated in the third step of the operation.

The transplant under these circumstances passes through five circulatory phases as follows:

1. When the dorsal digital arteries are divided as above detailed the finger flap newly approximated to the deep surface of the overlying abdominal integument must depend for its nutrition primarily upon such circulation as is available through the un-

divided pedicle of palmar tissue at the junction of the finger with the palm secondarily upon such nutrient fluids as are exuded from the abdominal flap. Heat and moisture are however supplied abundantly by the abdominal flap which having two pedicles is constantly very close to its normal circulatory efficiency.

It is during this phase that the circulation of the finger flap is most seriously jeopardized which is fortunate for two reasons. First because if failure either from sloughing or sepsis threatens or occurs the patient and the operator have much less at stake than would be the case at a later and more advanced stage. Second because at this time there is available the natural heat and moisture of the abdominal flap.

As union takes place between the apposed surfaces of the finger flap and the abdominal flap the finger flap adds to its sources of nutrition and begins to receive blood supply directly from the abdominal flap which in turn having united with the dorsal surfaces of the hand has now three pedicles instead of two. That this has taken place may be recognized clinically by the disappearance of the edema in both flaps which may be expected to be complete before the tenth day. The amalgamated flap now has the following sources of blood supply (a) undivided palmar skin directly continuous with finger flap (b) the newly formed vascular loops connecting the apposed surfaces of the digital and abdominal skin (c and d) the two lateral pedicles of the abdominal flap directly continuous with the abdominal skin and (e) the newly formed union between the proximal margin of the abdominal skin flap and the integument of dorsum of the hand.

3 This amalgamated flap now amply nourished is ready for transplantation after division of the lateral pedicles only, leaving for its nutrition the newly formed vascular loops connecting the apposed surfaces of the finger and abdominal skin flaps the undivided palmar skin and the newly formed union between the proximal margin of the abdominal skin and the integument of the dorsum of the hand.

This stage of circulatory development continues until the transplant is sutured into its freshly prepared site when the nutrition of its edges is assisted by the natural heat and moisture of the tissues to which they are approximated.

4 When the union of these edges has taken place the fourth phase is established in which the transplant has once again both the hand and the tissues to which it has been sutured from which to draw its blood supply.

5 The fifth phase is established by the amputation of the finger leaving the amalgamated flap now a transplant wholly dependent for its nutrition upon its marginal supply. In the case reported the supply at this phase was found to be so profuse as to necessitate the clamping of a small spurting point in the transplant when the finger was amputated.

The usual allowance of one third for shrinkage or retraction in the first class of cases where the transplant is to be a double faced flap only will be found far in excess of the requirements. There is practically no shrinkage and the usual allowance therefore will simply involve the necessity of removing redundancy later on. A transplant that comfortably fills the defect *full* without tension when transplanted will be ample.

This absence of shrinkage operates to advantage in two ways. It renders possible a better cosmetic result by reason of the greater accuracy obtainable in fitting the transplant and suturing it into its place and it is greatly to the advantage of the blood supply in that it maintains the integrity of the small arterioles, venules, capillaries and lymph spaces instead of subjecting them to torsion, compression and occlusion with the resultant stasis that inevitably follows higher degrees of contraction in which there is a material rearrangement of the relations of tissue planes and bundles and disturbance of the intercellular spaces.

Let the operator should be betrayed into fashioning too small a transplant in view of the foregoing it would be well perhaps to lay the emphasis of repetition on the statement that the transplant must fill the defect *full*. This will suffice.

This applies to an amalgamated flap only and in the modification to be hereafter described in which a simple flap is added to the amalgamated flap in the form of an appendage or upon the added portion is to be treated by the accepted rules governing allowance for contraction.

As to the ultimate fate of the phalanges, the law governing the transplantation of bone are too well known to need restating here. The terminal phalanx must be freshened and contacted with living bone if union is desired otherwise it. The phalanx will remain permanently and will not be resorbed. The c bone are not transplants *strictiori sensu* ; they are living in their natural beds and receiving blood supply through their nutrient arteries precisely as though the finger never had been disturbed. Should the level of the amputation of the proximal phalanx be such as to involve the nutrient artery, it would be well to contact the free end of the phalanx with the living bone of the hard palate if possible.

This technique is adaptable to various modifications to meet the requirement of different conditions which may be individual to the case in hand. The method is therefore available in procedures other than rhinoplasty. A partial rhinoplasty may be required it being possible to preserve the tip of the nose together with the columella and nares. In such a case the method was employed with the result reported herein (Fig. 2).

CASE REPORT

Mary G. Irish, 46, an avid 34-year-old car cleaner, told her history of nasal injury during her fall 2005 visit. She said she had been injured by falling down stairs when she was 10 years old. Ten years prior to her current complaint, she had been injured while running against a clothesline in the dark. Some bleeding about six months later there appeared a small middle swelling high on the top of the nose. This gradually increased until four weeks prior to her consultation with her, since which time it had increased more rapidly.

Occasionally sharp lancinating pains present in the tumor for a few seconds. More frequent recently. Aside from this the growth had been painless. No blocking of the nares, no snuffles and no discharge.

Ep staxis infrequent and never very severe
Last bleeding four months preceding consultation

Following cesarean section there would be a marked diminution in the prominence of the mass. No impairment of the general health or loss of weight. No specific history. No abortions and no miscarriages. Had four children the youngest four months old and healthy. Husband died eleven months previous to consultation of pulmonary tuberculosis.

Physiologic examination (General examination negative except that the urine was of slightly lower specific gravity than normal. No Wassermann reaction.)

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The postoperative course of the case as an eventful there is a moderate amount of serous discharge from the denuded area on the abdominal wall which was responsible for very slight maceration of the palmar skin and the skin of the finger flap. Dry boric acid powder plentifully applied daily kept the field of activity clean.

Nineteen days after the first stage was done the second stage was undertaken. The posterior nares were plugged and ether administered by intra tracheal insufflation. A wide incision was made around the tumor beginning on the right cheek at the upper extremity of the right nasolabial furrow, laterally to the mass and extending upward to and crossing the bridge of the nose then downward and terminating at a corresponding point on the left cheek. This incision was carried down to the bone care being exercised to avoid the lacrimal sac on each side. A mesial frontal incision was added to gain room the bleeding points tied and the glabella chiseled through above the nasal articulation. The nasal processes of the maxillary bone were divided in like manner removing an amount of bone sufficient to keep wide of the growth.

The entire mass was then pried forward and the septum divided with a Gigli saw introduced from above. The lower ends of the incisions on the cheeks were then connected by a transverse incision crossing the nose just above the tip and the Gigli brought forward through this incision thus completing the separation of the septum and freeing the mass which was removed. The packing in the posterior nares afforded efficient hæmorrhage and no particular difficulty with hæmorrhage was experienced. With a strong pair of curved scissors the remaining portion of the septum was removed as far back as was necessary in order to get well into healthy tissue and both nasal cavities were packed to control oozing while the amalgamated flap was released from the abdomen and prepared for suture to the face.

The nail was removed special care being exercised to see that no fragment of ungual tissue remained. The flap was shaped by cutting its edges with scissors to fit the defect and its edges were then split with the scalpel to permit of suturing the finger skin to the mucous membrane of the nasal cavity and the abdominal skin to the skin of the cheeks. The tip of the terminal phalanx was freshened and forced well into the frontal notch and an attempt made to retain it in position with chromic gut. This attempt failed. Chromic gut was used in the nasal cavity and silkworm gut on the cutaneous surface.

The plugs were removed from the posterior nares and a pair of Asch's perforated nasal splints inserted into the anterior nares. Dry dressing.

The position of the hand was secured by a plaster cast including the body above the waist the arm the forearm to the wrist the head and the neck. Three days later this cast was removed and the apparatus shown in the accompanying illustration substituted in its stead. This proved much more efficient and comfortable to the patient (Fig. 3).

This apparatus was constructed of ordinary half inch band iron and quarter inch wire mesh fastened together with roofing tins and rivets. It was intended to act as a cage within which the head was

confined within the limits of motion compatible with safety to the transplant on the one hand and comfort to the patient on the other. It was secured in position by a light plaster cast around the body and shoulder and the head and forearm were secured by bandaging.

Postoperative course. In spite of careful attention to cleanliness in the buccal and nasal cavities there developed a bronchitis with temperature ranging up to 101° F and the character of the sputum on microscopic examination together with the physical signs made it seem certain that it was putrid in character.

The hand was therefore released by amputating the finger through the middle of its proximal phalanx on the eighteenth day under local anæsthesia and no further surgical procedures attempted at this time. Figure 4 *a* shows the flap at this stage. The flap was later shortened by cutting away and discarding the remainder of the proximal phalanx and the tissues of the amalgamated flap were trimmed and fitted into position.

As the procedure was a disarticulation rather than an amputation it was not necessary to contact with living bone and the bone end was simply buried in contact with a remnant of the cartilage of the septum and secured in place by suture (Fig. 4 *b c d* and *e*). The old suture line at the root of the nose was reopened and the tip which failed of contact in the second stage refreshed and successfully secured in the frontal notch by suture. There remained at this time redundancies as is apparent in Figure 4 *b c d* and *e* which were removed four months later with the final result shown in Figure 5. There was primary union throughout both the lining and the cutaneous surfaces.

The wound on the abdominal wall was closed by curreating away the granulations and converting the quadrangular defect into a straight line which was sutured with silkworm gut.

The patient retains the olfactory sense and has no discharge or discomfort of any kind. The transplant has at the time of this writing (fifteen months later) withstood continued zero weather without frosting and has assumed nearly the normal color of the rest of the face.

Pathological Report. Prof. C. J. Bartlett. The specimen received consists of a considerable portion of a nose not including the lower end covered over on three sides with skin the other surface having been dissected from deeper tissues. The largest measurements are 40 mm long 35 mm transversely and 30 mm thick. The central part of the skin surface is convex not ulcerated. On cutting through the specimen after fixation it is found to contain a cavity occupying the larger part of its interior. This cavity is somewhat irregular larger toward the lower end of the nose than above. Its greatest diameters are 27 mm long 18 mm transversely and anteroposteriorly. The cavity is filled with a soft jelly like grayish mate

nal readily removed. The all over covered externally by skin is about 5 mm thick but varies somewhat in different parts. On the left side of the nose and for a short distance to the right of the median line anteriorly the all is made up of soft tissue only except for a very thin plate of bone on the posterior part of the left side apparently a small portion of the nasal process of the left superior maxilla. A considerable portion of the right all of the cavity consists of a plate of bone which from its location is apparently the nasal process of the right superior maxilla but is considerably larger than normal. Only a small piece of each nasal bone is present. The cavity though occupying the middle of the anterior part of the nose is not divided by any septum. At its posterior part a bony ridge is present apparently representing the vomer. On the right of this there is an oval opening in the wall of the cavity 5x3 mm in diameter by which it apparently communicates with the right all cavity. No subhyaline exists in the first.

Microscopically the all is epithelial a very simple structure. It is highly epithelial cell in most places only near the liver lapp. In part these are short columnar in shape here more flattened. Some of these cells are distinctly ciliated. Outside the cells are fairly compact connective tissue. In the portions with all there no bone is present the connective tissue is quite ascular makes up the all the epithelial lining and the skin. In place has considerable perivascular small round cell infiltration. The glial tissue contains fat. It consisted microscopically of granular tissue containing an occasional leucocyte.

The gross and microscopic appearance of the nasal cavity to be baggy stalk and lined with ciliated epithelium. From the large size of the nasal process of the right superior maxilla and the small size of the corresponding process on the left side it is quite possible that some congenital abnormal condition may have been the primary cause of the cyst.

Too much stress cannot be laid upon the necessity for the most painstaking care of and attention to the cleansing of the buccal and nasal cavities prior to during and subsequent to the second stage of whatever procedure is carried out in either a rhinoplasty or a cheiloplasty as a safeguard against pulmonary complications.

Correction of defects and modeling procedures are to be determined by the judgment of the operator as they are individual to the case in hand.

Cheiloplasty In cheiloplasty the only modification necessary in the first stage is with reference to the treatment of the digital

arteries. They are to be carefully preserved in this operation for two reasons that it will be necessary to permit of a complete suture of the entire perimeter of the defect in the mucous membrane of the mouth to the finger and palmar skin in order to seal off the wound from infection from the buccal cavity. It is therefore necessary in the second stage of the operation to divide the pedicle of palmar skin or the skin of the palm which it will be recalled is directly continuous with the finger slip and an important source of blood supply. Having been divided this palmar portion of the pedicle is dissected up free from the proximal phalanx for such a distance as is requisite in order to permit of its approximation to the buccal mucous membrane.

This reduces the sources of nutrition of the unaltered flap to one if the digital arteries are divided as recommended for rhinoplasty i.e. the newly formed vascular communications through the line of union of the abdominal skin or the dorsum of the hand. Reduced to so limited a nutritional supply as this and confronting the unavoidable septic conditions prevailing in the mouth union would be at best uncertain. With both digital arteries preserved however this condition does not obtain and union may be confidently expected.

The transplant is trimmed accurately to fit and fill the defect in the cheek. Its edges are then split all around to a depth of about one centimeter to facilitate the eversion of the suture line.

Two suture lines are here employed one the internal approximating the palmar skin edge to the edge of mucosa of the buccal cavity and the other the external approximating the free edge of the abdominal skin to the skin of the face. The internal suture line is completed first as this is the more difficult. A horseshoe suture is recommended.

When the external suture is placed uniting the dorsal cutaneous surface of the transplant to the integument of the face it will be found necessary to leave unsutured a small segment adjacent to the phalanx on either side for the reason that the pedicle of the transplant rests on the margin of rather than in the defect.

In the third stage when the finger is amputated the elevated pedicle is depressed to the general level of the cheek and the final suture of the cutaneous surface completed. At the discretion of the operator the phalanges subsequently may be dissected out of the transplant without anaesthesia and without jeopardizing the transplant.

It may be inquired at this point why the finger is not restored as is to be presently described in connection with the transplantation of large single faced flaps. Restoration is not practical for the reason that this would result in a clumsy stiff digit devoid of sensation and even though the tendons were preserved practically useless. The writer's experience with wrapping the entire circumference of the finger with skin flap has convinced him of the futility of the procedure.

Exstrophy of the bladder Considering the abundant blood supply obtaining in this form of flap it is well worth while to consider the applicability of this method to this most distressing congenital condition upon which so much effort and ingenuity have been expended with what seems to have been scarcely its full meed of reward. Here we have present every obstacle to union of tissue taken from the neighborhood. Strict asepsis is unattainable and the results to date have led to the abandonment of all attempts to restore the defective bladder and the present tendency is toward its elimination and the substitution of either the bowel or the vagina in its stead.

The main objects to be attained in an attempt at the restoration of normal conditions are first closure of the defect in the anterior abdominal wall and protection of the exposed fungating and often eroded vesical mucosa second provision for a container for the urine third provision for sphincteric control and fourth prevention of the formation of concretions as a sequel.

The transfer of an amalgamated flap provides for the attainment of the first second and fourth of these objects.

As regards the third it is conceivable that in selected cases a substitute for the sphincter might be supplied by the placing of a pre-sutured pad over the lower margin of the flap.

The technique for closure of the defect of the abdominal wall would be modelled after that already set forth for cheiloplasty preserving both digital arteries and including the palmar skin in the suture of the inner surface of the flap to the mucous membrane of the bladder. The margin of the defect would be incised and the mucous membrane and if possible the entire wall of the bladder raised for suture to the deep surface of the flap while the tissues of the abdominal wall would be sutured to the margin of the transplant and the abdominal skin to the edge of its dorsal cutaneous surface.

The opportunity of demonstrating clinically the practicability of this procedure has not yet been presented to the writer.

CLASS II

Class 2 includes those cases in which the area of the abdominal skin flap is to be very considerably in excess of the area of the finger flap. In this class of cases it is necessary to secure an abdominal skin flap exceeding the dimensions of the finger flap either in length or in breadth or in both and it may be requisite that the excess shall be either a combined flap presenting two epithelial surfaces or a simple flap presenting one cutaneous and one raw surface.

In this latter event the finger would serve only as temporary host or carrier upon which the desired flap was transferred from its original to its desired location and this service having been rendered the finger would no longer be desirable as a part of the flap and should be susceptible of restoration to its usual functions.

To meet these various requirements certain modifications based upon a consideration of the available blood supply are necessary. In this class cases may be divided as follows.

Division A Cases requiring an extension of flap in the long axis of the finger (a) the extension is to be a single faced flap (b) the extension is to be a double faced flap.

Division B Cases requiring an extension of flap in the transverse dimension of the finger (a) where the extension is to be a single faced flap (b) where the extension is to be a double faced flap.

Division C Cases requiring extensive single faced flap only

Division 1 Cases requiring extension of the flap in the long axis of the finger (a) flap to be single faced only

Such requirements would be presented by a case in which a previous rhinoplasty by frontal flap had met with disaster and in which it was desirable to restore both the nose and the area on the forehead from which the frontal flap had been previously removed. Here it is essential that the greatest possible amount of blood supply shall be available for that area of the abdominal flap extending beyond the tip of the finger and designed to fill the frontal defect.

Make the usual finger incisions as indicated in Fig. 1 carefully preserving the digital arteries and remove both nail and matrix. Make the proximal abdominal incision but do not make the distal abdominal incision. Undermine a previously described for the reception of the finger. Undermine also an area corresponding in size and shape to the size and shape of the extra flap or apron desired to fill the frontal defect.

Suture the finger in place beneath the abdominal integument and pack the space beneath the undermined extra flap or apron with gauze surrounded by perforated rubber tissue.

It is necessary that the base of the apron resting upon the tip of the finger should be the full width of the finger flap at this point as it is through this base that the apron must receive its nutrition from the time it is lifted off the abdomen until it shall have united in its permanent position and its marginal supply from surrounding tissues shall have become established.

In order that the nutrition supplied to the apron by the digital arteries shall be as abundant as possible the final separation of the previously undermined apron from the adjacent abdominal skin should be accomplished in three successive steps instead of at a single step by incising first the greater portion of one of the lateral boundaries of the apron thereby separating it from the nutrition afforded by the immediately contiguous abdominal skin and a few days later repeating

the procedure on the opposite lateral boundary. Again after a similar interval an incision should be made along the distal extremity of the apron so that when the time comes to free the finger flap the apron will have already become very largely dependent upon digital arterial supply for its nutrition but not entirely so as it is wide to leave undivided three or four small bridges of abdominal skin at equidistant points on the perimeter of the apron in order to prevent retraction (Fig. 13).

By this procedure the apron which at first receives its blood supply from the surrounding abdominal skin on all sides is gradually forced to call for its blood supply from its base i.e. from the combined flap and the digital arteries greatly to the benefit of the entire transplant as this results in all the small vascular channel undergoing compensatory hypertrophy.

When the transplant is freed from the abdomen and sutured to its new position such portion of the pedicle as shall of necessity be left unsutured at the root of the nose should be kept continually moistened to prevent desiccation.

When this type of flap has been fitted and placed a sufficient time should be allowed for the marginal anastomoses to become thoroughly established before withdrawing the digital supply by amputating the finger.

(b) *Cases requiring extension of the flap in the long axis of the finger the extension to be double faced flap* Finger incisions and proximal abdominal incisions are made as for cases in Group 1. The undermined area in this instance is twice the length of the desired apron of double faced flap. The distal half of the undermined area of abdominal skin lying beyond the distal extremity of the finger flap when the finger flap is placed in the abdominal tunnel is freed from the adjacent abdominal skin by incising its borders. It is folded into the distal end of the tunnel and immediately secured in place by silk worm gut sutures passed perpendicularly through both thicknesses of abdominal skin. The exposed defect left on the abdominal wall is brought together as much as possible and left to granulate.

Division B (a) Cases requiring an extension of flap in the transverse dimension of the finger the extension to be single faced flap The technique is the same as described for the production of an apron or extension in the longitudinal axis of the finger and the same principles underlie and govern the forcing of nutrition in the extension except that the extension or wing is fashioned with its pedicle resting on the lateral margins of the amalgamated flap instead of on the distal extremity. In place of the extension being fashioned all in one piece as when added in the longitudinal axis of the finger the desired amount of increased area is equally distributed on either side in two parts or wings one half thereof being added to each side of the amalgamated flap.

(b) Where the extension is to be double faced flap Here the abdominal skin can not be cut free and folded in to yield an extension of double faced flap without destroying its pedicle and to accomplish this lateral extension the finger next but one is utilized to supply extension on one side. Extension bilaterally of a double faced flap is not practicable.

Division C Cases requiring extensive single faced flaps only In this class of cases the finger is to be but the temporary host to the transplant and should be susceptible of restoration to its usual functions when the transplantation is completed.

Such a case would be fairly represented in the requirements for relief of the cicatricial contraction following extensive burns of the throat or neck where the chin is drawn well down to the sternum and other methods seem to promise only partial relief.

Should the amount of lateral extension required be extraordinary two fingers may be utilized to provide nutrition selecting in this event those two fingers which most satisfactorily meet the requirements *but avoiding the index finger if possible*. The modifications of technique necessary to accomplish this result are as follows.

The incisions described for the first stage of a rhinoplasty are made as for that procedure. The tissue flaps are reflected as for that procedure but not to so great an

extent. Here it is necessary to secure reflection enough to afford a base from which the superimposed abdominal skin may derive its nutrition but it is not necessary to secure any particular amount of spread of the finger flap. The soft tissues are therefore reflected from the dorsum of the finger and from the lateral aspects of the phalanges to a slight extent. Less than half of the greatest obtainable spread of flap is required.

The abdominal skin bridging from one amalgamated flap to the other is completely freed from the underlying tissue and the adjacent edges of the underlying finger flaps secured thereto with the least number of sutures possible. These sutures should be of horsehair (as this does not cause necrosis of the skin) carried on a fine needle (to minimize trauma) and should include in the tie not more than half a centimeter of skin surface to avoid occlusion of vascular channels. They should be tied just tightly enough to secure *coaptation not compression* of the flaps as we have to anticipate a moderate oedema and thus double suture line covers at the midportion a very considerable area of skin which has been separated from its normal blood supply from below.

The separation of this elongated flap may be accomplished in easy stages under local anesthesia as previously described for the forcing of blood supply to the 'apron' in cases of longitudinal extension.

The flap having been freed and its transplantation accomplished it is found that there are to be two granulating surfaces one under either finger in the new location. These should be lightly packed and treated the same as their predecessors on the abdominal wall. A light pad placed on the bridge of flap between will suffice to secure union of flap to the bed between these two pockets.

It is desirable to preserve the nail in this procedure and the finger incisions should be modeled after those shown in Fig 7.

The digital arteries are not seen or divided the tendons remain untouched and the resulting scars are brought along the dorso lateral aspects of the finger as described in the following section.

The liberation and restoration of the finger

Liberation of the finger from the transplanted flap is done under local anæsthesia. Incise flap by two incisions one over each lateral margin of the dorsal aspect of the phalanges from the tip of the terminal phalanx to the line of union with the skin of the dorsum of the hand thus leaving on the dorsum of the finger a strip of abdominal skin. Carry incisions down to extensor tendons only. Very carefully follow plane of union of the two flaps to and including the edge of the finger flap and the line of proliferation which should present on inspection the dermatization or epithelial outgrowth from the edge of the finger flap.

Free one side of the flap first throughout its entire length then free the other side and last release the tip. When taken in this order the dissection is facilitated as the tissues are held firmly and in a constant position.

Curette thoroughly the exposed bed of granulations upon which the finger skin has been resting and carefully check all oozing. Close the incision in the flap and apply light compression dressing.

If more than one finger be in the transplant one only should be liberated at a time and healing completed before the other is liberated.

For the restoration of finger freshen the edges of the outspread finger skin and replace in normal position securing the same by sterile bandage or adhesive plaster. Sutures are unnecessary except at the tip. The thoroughness and care with which the dissection has been carried out in liberating the finger will be a prominent factor in determining the bulk and mobility of the restored digit. The finger should be immobilized during the entire period of healing and for at least three weeks after union is complete. This rest of material assistance in securing mobility later on as it prevents that traumatizing of the tender new tissue which is invariably the result of mobility in healing tissues.

In closing I wish gratefully to acknowledge my indebtedness to Dr Leonard W. Bacon of this city who not only counseled and assisted me in the operative procedures carried out upon the patient whose case is reported in this article but who also by generous contribution of the fruits of his extensive surgical experience and wide acquaintance with surgical literature aided me in large measure in the development of the technique described herein and to Dr Arthur F. Runkoldt who administered the anæsthetic to the patient and prepared the photographs.

A STUDY OF POSTOPERATIVE PNEUMONITIS¹

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INTRODUCTORY

THERE is at present a most promising effort in many American Hospitals to analyze the histories and to determine the end results in surgical cases. This endeavor is manifesting itself in the conservative reports of the diagnoses made, the recording of errors in technique and the real end results of operative treatment as determined by a follow up system. As yet however not enough attention has been given to the analytical study and the accurate recording of facts associated with postoperative complications. The diagnosis and recording of these complications is too frequently left to inexperienced internes, the study of them is neglected by the busy surgeon. The average hospital report is accordingly deplorably inaccurate and misleading in the tabulation of these important conditions.

During the summer of 1914 unusual findings in thoracic radiograms of patients having unexplained rises in temperature on the first and second day after operation stimulated the interest of the writer in the study of postoperative lung complications. The demonstration that patients showed lung shadows in their radiograms before the appearance of signs of consolidation and that these signs in not a few cases did not appear until after the temperature had dropped from the initial sharp rise attracted the attention of the surgical staff of the Presbyterian Hospital to these cases of so called postoperative reaction. The analysis of these cases began in January 1915 the intensive bacteriological study of them in 1916 made possible by a special fund donated by a friend of the hospital added a scientific interest to the investigation of this complication.

In 1915 and 1916 among 3719 patients operated upon 97 cases of pneumonitis were diagnosed and studied on the surgical service of the Presbyterian Hospital. The analysis of these cases is given in the following pages.

To demonstrate the result of a stimulated interest and co operative effort on the part of the staff to diagnose this complication it may be pointed out that in 1808 Schultze (1) reported 27 cases of pneumonia following 574 anesthetics in the Presbyterian Hospital 16.05 per cent and in 1913 and 1914 the two years preceding this investigation only 41 cases were recorded.

This study is continuing and at present is being conducted along three lines of investigation the bacteriological the radiographic and the prophylactic. At present the sputum of every patient on the morning of the operation is sent to the bacteriological laboratory where it is injected into a mouse. If the patient after operation shows any signs or symptoms suggestive of a respiratory complication a postoperative specimen of sputum is sent one or more times for mouse inoculation. Unless the patient's condition contra indicates it the chest is radiographed. An analytical chart for careful recording of symptoms and chest findings is begun and daily notes are made of the chest examinations (Fig. 1). If the patient shows the signs or shadow of lung involvement a blood culture is made and if the pre operative and postoperative sputum specimens show pneumococcus IV a specimen of the patient's blood is sent every third day for agglutination tests with the isolated pneumococcus strains to determine the identity and grouping of the pneumococcus in its relation to the lesion found.

Thus far as a result of a combined bacteriological radiographic clinical and to a limited extent a postmortem study of these cases we have found that every type of pneumonia may follow operation. The graver forms such as the lobar the embolic and the gangrenous types have been described by writers in the German clinics. But the mild and most frequent form of postoperative lung complication whether or not it be a pneumonia in the strict pathological inter-

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The Presbyterian Hospital

IN THE CITY OF NEW YORK

N 2

H y

Y

At

D

Operation

Operator Dr

Anæsthesi st

Time of Anæsthesia

Untoward Symptoms Occurring During Anæsthesia

C a (1) V m t g () I e mucu (3) A f t of n tu (4)

History of Recent Concurrent Respiratory Trouble Before Entering Hospital

R e t ld (1) C gh (2) B ch t s (3) T ll t s (4)

L po u fu g m t (1) foll g a l m on b th (2) f m operat ng room t w rd w th le gth
f t m (3) ft pe t t ll p t nt b d (4) wa d after p r t n (5)

Mode of Life and Habits of Patient

W o k n d r (1) ut doo () w tt der ear (3) woolen u d rwa ut (4) more tla

e t (5) t k ld b tl (6) hot bath (7)
N mbc f bl k t p t t l p nd 1 2 3 4 tc

Patient Has on Admission Physical Signs of Inflamed Condition of Respiratory Tract

Rh t (1) T ll t (2) l h v g t (3) lary g t (4) Br nch t (5) P l m n ry T be c l (6)

Cardio Vascular and Renal Systems on Admission

N mal (1) Val u la D e () Arrhythm a (3) Ta h a d a (4) In ufficiency (5) Th ckened Pe pheral
A t (6) H p rt w th blood l u (7) N ph t (8)

Disease

Symptoms of Onset in Order of Appearance With Date (underline important one)

C ough (1) P n h t () Dy p cea (3) Ch ll (4) R p d e p a t o (5) Cy (6) T mperature
() Ru ty p t m (8)

Marked Symptoms during Attack (underline important one)

Cough (1) P ch t (2) R ld p t (3) Cy (4) Ru ty putum (5) H p (6)

Temperature Remained Over 102 F note number of days 1 2 3 4 5 etc)

Blood Count Date W B C

Differential

Signs of Congest on or Consolidat on Made Out in

R U L (1) R M L () R I L (3) I U L (4) L L L (5) E t t e R ght (6) E t L ft (7)

C t o D t

C l d t l b l (1)

C sold t l b r (2)

N r h d th g f sol l t D t

N g f l d t o th n N ay l l D t

N v h d w d f s l l t g Date

N r h w d h l w l f k f l l t f d

N r v h d l g h f t h l Dat

N N t k

Cardio Vascular and Renal System During the Disease

Blood I s e

P lse St g (1) W k (2) R g l (3) I g l (4) R t

Heart A hvtl (1) F b ll t t (2) F l v l a (3) I f t c y (4)

Kidneys

A l l (1) N pl t t t

Complications

F m p v æ m (1) L b (2) Se f b l y (3) O t t (4) P t l a b s (5) P cum c

P t t l l (6) D f se (7)

Postoperative Respiratory Diseases Other Than Pneumonia

B h t (1) Pl y (2) Embol (3)

Bacteriology

P m I (1) II (2) III (3) IV (4) N hæm lyt St ptococ (5) Hæmolyt Str pt c cc

(6) B ll I l l enza (7) F dl d B ll (8) N g m d (9)

A te t t e put m Dat

I t p e t p tu Dat

Blo d lt Dat

Aggl t t

B l d w th p t A t t t (1) I t p e t e (2)

P ophyl cnc Measur es

I m b d j k t (1) D g t l M N 4 d (2) B tl R les (3) Co ter t t o w th l n nt

(4)

Treatment

Op (1) S um (2) C p t t (3) D t l (4) O t r t m l t n

Final Result

Autopsy

Fig A l y t l h a t ed by the P b y t i a H o p t l N w Y k

pretation of the lesion has not been accurately described. It is this type that is usually overlooked under the casual term postoperative reaction. It is this variety that has especially interested us. It is marked by definite enough characteristics to classify it as a clinical entity. These characteristics may be summed up as follows:

The onset is usually sudden within the first forty-eight hours after operation *without* an initial chill but with a sharp rise in temperature. There is usually a moderate cough and at times a moderate pleuritic pain. The temperature seldom continues high but within twenty-four to forty-eight hours begins to fall by *lysis*. During the first few hours of initial high temperature the radiogram shows a shadow in the lungs usually in one or the other lower lobes frequently triangular or wedge shaped. At this time the physical signs are dullness over the corresponding area posteriorly with diminished breath sounds. Bronchial voice and tubular or bronchial breathing necessary for diagnosis of consolidation do not appear as a rule for twenty-four hours after the appearance of the initial shadow and after the drop in temperature. Rusty sputum is exceedingly rare in this type. The sputum as a rule a yellow mucus usually shows a pneumococcus IV in both the pre-operative and postoperative specimens. Many of these cases show agglutination of either one or both of the pre-operative and postoperative pneumococcus IV in the serum of the patient taken seven to fourteen days after the onset of the complication. This type usually occurs in otherwise healthy individuals giving the history of a recent or concurrent cold at time of operation. Unlike associated with serious conditions this type of lung complication is seldom fatal but the cough frequently prolongs the convalescence and in not a few cases especially of upper abdominal coeliotomies causes a widening of the scar with later postoperative hernia.

LITERATURE

The literature in English concerning pneumonitis following operation is very meager and unsatisfactory. Some ten years ago

the subject was thoroughly discussed by several workers in the German clinics notably Henle, Bibergeil, Lichtenberg and Kelling. The latter presented the subject before the thirty-fourth congress of German Surgeons in 1905 and many of the leading surgeons discussed his paper at that Congress.

STATISTICS

In general statistics regarding the incidence of the complication in different clinics varies largely with the care given to its detection. The following table shows the variation in the percentages:

TABLE I—VARIATION IN PERCENTAGES

Bibergeil Korte (2) reported 3.5 per cent in 3909 coeliotomies
Lewisohn Czerny (3) reported 3.9 per cent in 1302 coeliotomies
Grimm Kuemell (4) reported 2.5 per cent in 1734 coeliotomies
Laewen Trendelenberg (5) reported 5 per cent in coeliotomies 1 per cent in all surgical cases
Henle von Mikulicz (6) reported 8 per cent in coeliotomies
Kausch von Mikulicz (7) reported 2.4 per cent in coeliotomies
Kroenlein (8) reported 0.5 per cent in coeliotomies
McClure (9) reported 0.77 per cent in 3100 postoperative cases at the Johns Hopkins Hospital in 1915
Whipple reports 97 cases or 3 per cent in 3190 postoperative cases at the Presbyterian Hospital in 1913, 1916

ETIOLOGY

Predisposing factors may be grouped under the following headings:

A. Local inflammations in the upper respiratory tract and factors favoring them.

B. Vasomotor changes causing a congestion of the pulmonary vessels.

C. Factors inhibiting the normal thoracic and abdominal respiratory movements and favoring atelectasis and hypostasis in the lung.

D. Local or general infections elsewhere than in the respiratory tract.

E. Debilitated states resulting in a lowered natural or acquired immunity to the particular organism inciting the pneumonia.

F. Factors increasing the virulence of the inciting organisms.

A. Local changes in the respiratory tract due to infection or congestion and factors favoring them. (1) These changes inflamma

tory in nature are usually complained of by the patient as a cold in the form of a coryza tonsillitis pharyngitis laryngitis or bronchitis. Any one or several of these conditions may be actively present or in a subsiding phase when the patient enters the hospital. Thus was the case in 21 of this series the majority of these patients coming in with acute surgical conditions where the operation was not one of choice. These colds are of course most frequent in the winter and early spring (Table II).

On the other hand the patient may easily contract his cold after entering the surgical service. Five patients in this series complained of contracting a cold after admission. These colds may be the result of one of the following factors. He usually comes into the hospital too warmly dressed — many of the patients wear more than one suit of heavy underwear he is given a hot bath and is either put to bed or allowed up and about the cool ward with far less clothing than he is accustomed to wear. During the twelve to twenty four hours before operation he may be examined in a more or less exposed condition one or more times. He is given his preparatory shave and is exposed still more in the early morning hours as a result of catharsis and enemas. It may be that coming to or from the operating room he is exposed to cold draughts in the long corridors so characteristic of hospitals. During his recovery from the anæsthetic with his vasomotor system depressed he may become chilled especially if his bed clothes do not cover his shoulders and on the average neatly made hospital bed with blankets shrunken from repeated cleaning the bed clothes seldom come above the costal margin. A small shoulder blanket may or may not make up for the deficiency. Many of the patients are not accustomed to sleeping in a cold room and particularly under an open window. Too often the modern interne or nurse with a disdain for draughts and cool temperature forgets that the twenty four hours before and after an operation is not the best time to correct habits and customs of a lifetime. The writer is firmly convinced from repeated observations in several hos-

TABLE II — INCIDENCE

In decades	915	96	Total
to 9	3	0	3
10 to 9	4	7	11
5 to 29		13	5
3 to 39	8		25
40 to 49	4	5	9
5 to 59	8	7	5
60 to 69	3		5
70 to 9			3
Month of the year			
January		8	
February	4	6	
March	8		0
April	4	0	0
May	5	3	8
June	1		
July			3
August			4
September	6	4	
October		4	6
November	7		9
December		6	
Missed	3	3	64
Total			33

pitals that one of the most important predisposing causes of postoperative pneumonitis both in patients coming into the hospital with a recent cold or free from an active cold is the exposure to which he is subjected during the first twenty four to forty eight hours of his stay in the hospital.

Factors causing an irritation of the mucosa of the respiratory tract. This irritation may then lead to bacterial infection and to extension beyond normal barriers into the bronchi and alveoli.

The irritant action of the gases of general anæsthetics particularly ether is most noticeable in the mucous membrane of the pharynx with the resultant accumulation of mucus. The churning action of the stertorous breathing in deep anæsthesia thoroughly mixes the saprophytic bacteria of the mouth and tonsils especially the group IV pneumococci with this mucus and a descending infection of the bronchi results either during anæsthesia or later during the recovery from anæsthesia. Of course in improperly prepared cases or in patients with an ileus the vomitus adds to this danger. This infection of the bronchioles with the subsequent incomplete aeration of the lung and atelectasis of some of the alveoli is probably the pathogenesis in the majority of the surgical pneumonitis cases.

TABLE III — TYPE AND METHOD OF ANÆSTHESIA

Type and method of anæsthesia used in this series	1915	1916	Total
Gas ether sequence closed method	24	33	57
Ether drop method	6	4	10
Ether intrapharyngeal	2	1	3
Gas oxygen-ether	2	5	7
Gas oxygen	8	5	13
Chloroform	0	1	1
Local anæsthesia novocaine	2	4	6

Percentage of cases following each type of anæsthesia in proportion to the total number of anæsthesias of each type given during the year

Ether	4	35	28
Gas oxygen	1	12	16
Chloroform	0		
Local anæsthesia novocaine	16	46	31

Untoward symptoms that occurred as noted on the anæsthesia charts

Cyanosis	2	11	13
Vomiting		3	4
Excessive mucus in the pharynx	4	8	12
Aspiration of vomitus	1	1	2
Patients giving a history of recent or concurrent cold	8	13	21
Patients giving a history of contraction of cold after admission to the hospital	2	3	5
Patients having on admission physical signs of an inflamed condition of some part of the upper respiratory tract	0	1	20

Type of anæsthesia used in the cases giving history or signs of a recent or concurrent cold

Ether	1		23
Gas oxygen ether	1		3
Gas oxygen	3	3	6
Local anæsthesia novocaine	0		

By comparing the anæsthesias given in this series (Table III) it will be seen that postoperative pneumonitis occurred after every form of anæsthesia used and even after local anæsthesia. It is a mistake to speak of postoperative pneumonitis as an anæsthesia pneumonia or ether pneumonia. General anæsthesia is not the sole factor. In Henle's report (6) pneumonia occurred more frequently after local anæsthesia than after any one of the general anæsthesias. In proportion to the number of anæsthesias the percentage in our series after local anæsthesia was greater than after any one of the general anæsthesias. Nevertheless it must be said that in the Presbyterian Hospital both gas oxygen and local anæsthesia are used far more frequently in cases where the

predisposing factor of recent or concurrent cold is present and this is one reason for the unexpectedly high percentage of subsequent pneumonias in these anæsthesias. Many such cases do not develop a pneumonitis with these anæsthetics.

There is no doubt that ether is the anæsthetic most irritating to the mucous membrane of the oropharynx particularly where there is any acute or chronic inflammation present at the time it is administered and for this reason it should never be used in a case giving a history, or physical signs of recent or concurrent cold. Chloroform, gas oxygen or local anæsthesia according to their individual indications should be the anæsthetics employed in such cases.

B Factors causing a congestion of the pulmonary vessels. This congestion may be one of the phases of inflammation due to bacterial invasion as in a bronchitis or it may be caused by the increase of carbon dioxide in the blood as seen in the cyanosis of gas oxygen anæsthesia. This congestion may be due to obstructed respirations as seen during and immediately after anæsthesia or it may be due to defective respiratory excursion or in the feeble and aged to undisturbed or unchanged recumbent posture or it may be present with cardiac decompensation associated with valvular disease or with lowered blood pressure following shocking and long operations. This pulmonary congestion may follow exposure in a surgical case in the same way that it does in every day life preceding a croupous pneumonia. In four cases of this series within one to four hours after operation cyanosis was very marked and the pulmonary congestion went on to an actual pulmonary oedema. This oedema cleared up under active counter irritation.

This congestion may be localized to one lobe or part of a lobe following a pulmonary embolus. In some cases of pulmonary embolus that survive the area of congestion does not go on to consolidation in others a pneumonic process develops but not necessarily as a result of hematogenous infection the bacterial invasion may be and usually is a descending one.

TABLE IV — ANALYSIS OF OPERATIONS PERFORMED IN THE 97 CASES THAT DEVELOPED A POSTOPERATIVE PNEUMONIA

H ma	28
Appe d	
St m ch	7
Gall bladder	8
Intest l	
Om tum	
I l c	7
I erit t	6
L pl torv calhot my	0
Bladder	
Kid y	
Thy d	
Laryn	
Tongu	
I nsl	3
I	
R ctum	
I t mut	4
I t l calhotom	88

C Factors inhibiting the normal respiratory excursion and so decreasing respiratory function These factors may be grouped as follows

a Trauma to the thoracic and abdominal wall incident to the incision and retraction of the operation cause peritont pain and a splinting of the thoracic or the abdominal muscles of respiration

b Inflammation of the peritoneum causing the same splinting of respiratory muscles

c Distention following peritonitis and coeliotomy This causes a limitation of the diaphragmatic excursion

d Tight binders and surgical dressing

These factors are undoubtedly very marked and account for the very large percentage of pneumonias associated with calhotomies as compared to operations on the extremities. In this series 88 of the 97 pneumonitis cases followed abdominal incision. Czerny (10) was the first to emphasize the rôle of pain in the abdominal wound as a factor in preventing sufficient aeration of the lungs and expectoration of the mucus in the trachea

D Local or general infections elsewhere than in the respiratory tract Bacteria either free in the circulating blood or carried along in an embolus from an infected thrombus are very liable to produce a so called septic pneumonia. These pneumonias are usually the late and often the terminal pneumonias

TABLE V — PHYSICAL SIGNS AND RADIOGRAPHIC FINDINGS

Signs of consolidation	W e l c t e d	1915	1916	Total
Right upper lobe				
L obula		0	0	
Loba		5		7
R ht m d d l l b				
I b l		0	0	
I b				3
R g t l r l b				
L b l		5	6	3
L b		6		6
Left upper lobe				
I b l			0	
I l				
Left l l l				
I b l		9		6
I b		5	4	9
R g t l l l l d			6	47
Left l l b n o l d		4		35
I t l g t l g		3	3	6
I t l f t l g		4		5
I c s o l d a t				6
S g o f c s o l d t i o t l				
I v l d		5	6	
I v l d n l g o f c				
s o l d t g d			6	48
I h d b d b e f r e				
I g p p e l		5	6	
I m l x f d o k p h d		9	43	7
I m b f c a t d o k p h d		5	0	5
R d p l l d d h p e d				
h d		7		9

In this group must be classed the true pneumonias occurring in cases of pneumococcaemia with the first focus elsewhere than in the lung. In our series there were even of this type following a pneumococcus focus elsewhere

L Debilitated conditions causing a lowering of a natural or acquired local or general resistance to the particular organisms exciting the pneumonia This lowered resistance may be caused by any one or more of the states of lowered vitality of the patient such as is seen in shock, hemorrhage, infection elsewhere in the body than in the lung, cachexia and constitutional disease and toxic states

I Factors increasing the virulence of the exciting organism These are not definitely understood but is fairly agreed that in the winter and spring months with the increase in pneumonias repeated passage from favorable host to host increases the virulence of the pneumococcus. This entire question is closely related to the epidemiology and recurrent changes in the virulence of the

disease and to the hygienic conditions and overcrowding of urban population and to the congestion of stores and public buildings during the holiday seasons Cole (11) in his Harvey Lecture has discussed this phase clearly and fully

INCITING CAUSE

That there is an inciting cause in the form of some micro organism in every case of fibrinous or croupous pneumonia is generally accepted This probably holds as true in the so called postoperative pneumonia or surgical pneumonitis Considering the varieties of postoperative pneumonitis classified according to their predisposing causes it will be evident that the pneumonitis occurring with general or local infections associated with a bacteriæmia are more apt to have pyogenic organisms as the inciting cause whereas in the pneumonias where descending infection operates with the factor of lung congestion the pneumococcus either parasitic or saprophytic in the oro pharynx is the usual inciting cause

Even before the identification of the pneumococcus as a bacteriological entity efforts were made to reproduce the typical lesion of lobar consolidation of the lung in animals Since the discovery of the pneumococcus these attempts have been directed chiefly along two lines i.e. insufflation of cultures of the pneumococcus into the trachea or injections of the cultures intravenously Within recent years the experiments of Wadsworth (12) Meltzer and Lamar (13) Meltzer and Wollstein (14) and Winternitz and Kline (15) stand out most prominently But Wadsworth's studies of the relation between the virulence of the pneumococcus and the resistance of the host is the noteworthy contribution to the study of the pathogenesis of pneumonia in its reproduction in animals He showed conclusively that the reproduction of the typical lesions of lobar pneumonia in the rabbit depend upon two factors either the resistance of the animal has to be raised by immunization to the pneumococcus for it to develop a lobar pneumonia when a virulent organism is insufflated into the trachea or the virulence

TABLE VI — SYMPTOMS

Symptoms of onset	1913	1916
Cough	0	32
Pain in chest	10	30
Dyspnoea	9	8
Rapid respirations	14	18
Cyanosis	7	3
Temperature	30	38
Chill	2	
Rusty sputum	1	4
Symptoms during attack		
Cough	5	4
Pain in chest	17	37
Rapid respiration	4	30
Dyspnoea	1	13
Cyanosis	11	9
Rusty sputum	8	6
Herpes	1	
Temperature remained above 101° F		
1 day	8	13
2 days	2	9
3 day	13	6
4 days	4	3
5 days	4	1
6 days	1	1
7 days	0	3
8 days		1
9 days	0	1
10 days		1
15 days	0	1

of the pneumococcus has to be very much attenuated If these conditions are not met the animal dies of a general infection or the lung lesions are absent or atypical

But it is the study of the serology of the disease and the biological classification of pneumococci by means of immunity reactions that has established the etiology of the disease Neufeld and Haendel (16) in 1909 first recognized the possibility of dividing pneumococci into groups by means of the reactions of immunized animals to these several strains Their work was incomplete, however and it was at the Rockefeller Institute that the biologic classification of the various strains of pneumococci was established Dochez and Gillespie (17) reported this work in 1913 Since then a great quantity of work along bacteriological and immunological lines has been carried on at the Rockefeller Institute and elsewhere establishing the relation of the pneumococcus to the well known fibrinous pneumonia It is an established fact that pneumococci can be divided into at least four groups Groups I II and III may be called parasitic inasmuch as they do not occur in the normal throat or when present are there as the result of the individual having

TABLE VII — ANALYSIS OF THE BACTERIOLOGY
97 CASES

Cases in	h h p tu	s c l t d	P op t	P p t
by m se oculati n			34	69
C e n hich p t	n t		63	8
u d				4
Gr p I p n umococ	i d			
G o p II p umoc	f d			
Group III p moc	i d		3	
G up IV p eum	fo nd		4	46
B cillus inil	æ			5
St ept				
B llus mu s s pul t				4
Cultu es	n g t i		4	5
Pe c nt ag of p i t	p t			
h w gnc m xoc	IV			4
ferc nt s f pot pe t	p t			
h gpn m s IV			7	
P c tag f p e op t	n l			
postop t p t h	p			
m s IV			48	
C e n h h l l i	lt l			
Blo d lt t l			48	
Bl l c lt f it f pn				
oc I				
Ll d ultu i t i f n				
ococ II				
Blood lt po t i pn				
n c s III				
Blood c lt e i t i p u				
m cus IV			4	
Bl d ho d t ptoc c			4	
P t nt run sh d g l tin				
f p ope t t p IV			4	
P t nts s h w d l t n t				
l th p ope t d pot pe				
t f ut G o p IV				

been exposed to a patient in the course of or convalescent from a pneumonia of one of these group. The fourth group spoken of as the heterogeneous group is saprophytic in the throats of normal individuals at least it is found in some 60 per cent of throats. In this group are placed all the strains of the pneumococcus that do not agglutinate with the serum of animals immunized to the Group I and II and that do not show the very definite cultural and staining characteristics of the Group III strain. The strains in Group IV are individual in their agglutination reactions or at least have been up to the present time so considered. That is to say the members of the Group IV as distinguished from the members of Group I and II do not characteristically cross agglutinate with one another.

Up to the present time the bacteriological investigation of pneumonias occurring after operation has been neglected or confined

TABLE VIII — MORTALITY STATISTICS 97 CASES

T tal d aths	5
Pe c nt ag f mo tality	25
N mb of autopsies	8
Patients dy g f p e mon s the nly c m	7
plcat	9
fatal cases ha g p umococæm	5
i t l mb l e p eumonia	2
l tal spi ati p e mon s	3
l tall b r p umoni s	3
l tal lobul pn m as	4
Assoc t d d to s	
C om f t gue	3
C ma of tom h	3
P nt n ll b e s	
Il p t f h v of p t t	
l ly is of oc l cho d	
Ch c ppendic t	
Il	
Ch l l th	3
Il	
C e n h h l l i	
l t t i	
l eumococ pe t t	3
l ococ t omv lts	
Ac t ppe l t	1

to the cultures of exudate in the lungs at the time of autopsy. There has been no attempt so far as the writer is aware to determine the etiological relation between so-called postoperative pneumonia and the several strains of pneumococcus. The study of this problem was begun at the Presbyterian Hospital last year and is being continued at the present time. The preliminary report of the detailed bacteriology of this work is to be published by Miss Miriam Olmstead, Resident Bacteriologist of the Hospital who has conducted the bacteriological investigation (18). A brief resume of the work is given here.

A pre operative specimen of sputum of every patient is injected into a mouse and if a pneumococcus is recovered it is cultured and kept for comparison with the pneumococcus isolated from the postoperative sputum of the patient by mouse inoculation if he shows any evidence of lung involvement after operation. If the patient develops a pneumonia and the pre operative sputum has shown a Group IV a specimen of blood is taken at three day intervals for serum agglutination tests with the pre operative and the postoperative strains if the latter proves to be a Group IV. In the cases showing a Group IV in both the pre operative and post

operative sputum specimens rabbits are immunized to these strains and the serum from these rabbits is used for testing the cross agglutination of the pre operative and postoperative strains of the Group IV isolated from other patients developing a postoperative pneumonia

As this work progresses it is becoming more evident that the majority of the postoperative pneumonias have the Group IV in the sputum especially is this true in the cases of the milder type of the disease in which it develops in otherwise healthy individuals and runs a short atypical course. It is becoming more evident that the Group IV is the etiological or inciting factor for the following very definite reason

In an increasingly large number of the patients developing the type of the disease mentioned there is found a pneumococcus IV in both the pre operative and postoperative sputum. The serum of the patient taken at the time frank signs and lung shadow are present and three days subsequently does not agglutinate the pre operative or postoperative strain but the serum taken three to twelve days later has in many of the cases agglutinated both the pre operative and postoperative strains of the Group IV isolated from the sputum by mouse inoculation. The failure of the patient's serum to agglutinate these strains for a period of several days is strong evidence that the patient did not have an immunity against the pneumococcus IV prior to the pneumonia and the appearance of agglutinins in the later specimen of serum is strong evidence that the lesion in the lung was caused by the Group IV and that the immune bodies against the Group IV were produced as a result of a definite lesion.

As a result of the work of the investigators at the Rockefeller Institute in the grouping of the pneumococci it has been possible to correlate the various clinical types of pneumonia with the four groups of the inciting organism. It is now well recognized that the Groups I, II and III are the inciting organisms in the severe typical medical cases of pneumonia and that the Group IV is the more usual finding in the less severe and

shorter atypical forms of the disease. Although Wadsworth carried out his investigations in the pathogenesis of the disease before it was known that the pneumococci could be divided into definite groups because of their biological characteristics his observations on the interrelation between the virulence of the organism and the resistance of the host in the production of the lesions in the lung are just as valid today as at the time he published them. In fact the determination of their biological characteristics has added to the interest of the relation of the groups of the pneumococci to the type of the pneumonia. For in his experiments Wadsworth (12) showed that Owing chiefly to the fact that the lung surface acts as a barrier to systemic infection the development of acute exudative pneumonitis offers an especially clear example of the nice balancing of the essential conditions determining infection. These conditions are, on the one hand the specialization or virulence of the incitant and on the other hand the animal susceptibility both local and systemic. Organisms of low virulence induce evanescent bronchial reactions more virulent organisms by a local infection give rise to the more typical broncho-pneumonic lesions while organisms of still greater virulence if confined to the lung incite diffuse processes of lobar type but if not so confined and bacteremic infection occurs the lung lesions are less marked and of the broncho-pneumonic type.

The variations in the virulence of the many strains of the Group IV pneumococcus and the variation in the degree of susceptibility of the surgical patient as a result of the various predisposing factors which may alter his local or general immunity to the disease accounts for the very marked variations in the clinical symptoms and the physical signs of these postoperative pneumonias especially those occurring in the previously healthy individual. It is interesting to note that Carriere (19) in 1898 noted a marked attenuation in the virulence of the pneumococcus which he isolated from cases of *maladie de Woille*, that at autopsy showed nothing more than a lung congestion. In the light of the investigations in the grouping of the pneu

mococci it is probable that he was dealing with the Group IV pneumococcus. This group is as a rule far less virulent in the mouse and rabbit than the parasitic groups.

To sum up the pneumococcus IV was found in the sputum in 30 per cent of the surgical cases examined before operation. In 1916 the pneumococcus was found in either pre operative or postoperative sputum of 88 per cent of the pneumonitis cases. It was found in both pre operative and postoperative sputum in 42 per cent of the patients developing a postoperative pneumonitis. It was found in the majority of cases having the short atypical pneumonias appearing within 48 hours after operation. In many of these cases the pneumococcus IV isolated from both pre operative and postoperative sputum proved to be the same strain by positive agglutination tests with the patients' serum after one or more negative agglutination tests. The clinical histories of these cases suggest a lowering of local resistance in the lung to the pneumococcus IV as a result of bronchial irritation or pulmonary congestion. Because of these findings it seems justifiable to consider the Group IV pneumococcus the inciting factor in the majority of postoperative pneumonitis.

PATHOLOGY

The term surgical or postoperative pneumonitis includes every well recognized pathological type of pneumonia — lobar, lobular, broncho-embolic, hypostatic, gangrenous — as well as a variety that may be considered atypical. This variety so seldom comes to autopsy and has hitherto been so little appreciated clinically as a form of pneumonia that it has not been recognized as a pathological entity. In this type occurring as a rule within the first twenty-four to forty-eight hours after operation giving a lung shadow and physical signs of consolidation in some cases for not more than twenty-four hours the characteristic feature is a marked engorgement of the pulmonary vessel with rapidly disappearing exudate in the alveoli

but without organization of the exudate. This engorgement is evidenced by the serial radiograms showing resolving shadows within twenty-four to forty-eight hours by the transient physical signs of consolidation and by the rare autopsy findings in cases dying of some other lesion but in which cases the lung

usually one of the lower lobes — shows the engorgement of capillaries, early exudate in the alveoli and beginning collection of leucocytes and red cells. This is the pathological picture of the first stage of inflammation and is not infrequently seen in the outer margins of a lobular patch of pneumonia or in a lobe where the pneumonic process is beginning after consolidation has occurred in another lobe. In such lungs in the gross the involved lobe or part of a lobe is heavier than normal, less air containing has a beefy feel and considerable pinkish fluid exudes from the cut surface. But hepatization as such is not seen either grossly or microscopically.

It is only on this basis that the abortive or short lived lung shadow and physical signs of dullness, diminished and bronchial breath and voice sounds in so many of the Dresbysterian Hospital series can be explained. Only one of this type in this series came to autopsy. This patient was a young woman operated upon under ether anesthesia for dilatation of a stricture of the rectum. A perforation occurred not recognized at time of operation and she died within thirty-six hours of a general peritonitis. Ten hours before she died she developed dullness, distant broncho-vesicular breathing over the posterior part of the left lower lobe. She was radiographed and there was a shadow in the left lower lobe. The autopsy showed no hepatization nor definite consolidation but very marked congestion of the vessels with exudate in the alveoli devoid of fibrin. The two lungs removed at the autopsy and radiographed showed the same relative shadow in the left lower lobe.

Whether this lesion should be termed a type of pneumonia or an abortive type or an early stage of pneumonia is a debatable question but that it corresponds with the earliest picture of a pneumonic process and that it does occur in many postoperative

Th h t h h d pu m l k f m p
f h l pe t g mp d h l l f f mose
iv hy d d f so ed ty th Rock ill
lms

patients is borne out by the findings in this series

The type of pneumonitis just described is not limited to surgical cases. A clinical entity described first by Woillez in 1848 (o) and since then called by the French school *maladie de Woillez*, resembles these cases of pneumonitis coming on soon after operation. Carrière (19) has given a very comprehensive description of these cases both clinically and pathologically. The disease seldom fatal offers few opportunities for postmortem study, but Carrière's autopsied case showed the following points of interest. The involved lobe was heavier than the unaffected ones. It had a beefy feel posteriorly, crepitated slightly, and the cut section showed a frothy reddish fluid. The less affected portion of the lobe showed emphysematous alveoli. Microscopic sections of the involved lobe showed a very marked engorgement of the capillaries about the smaller bronchi and alveoli, the alveoli dilated and filled with a very peculiar exudate. This exudate contained *no fibrin* but a mucous staining pink with eosin; it contained numerous red cells, desquamated epithelial cells, mononuclear leucocytes and eosinophile cells and mast cells.

Bacterial stains showed marked predominance of gram positive capsulated diplococci. Cultures grew pneumococci which proved to be a strain of relatively low virulence when injected in rabbits.

It will be seen that this type of pneumonitis recognized by the French as *maladie de Woillez*, has a very striking resemblance to the type of pneumonitis occurring shortly after operation in otherwise healthy individuals. Although the cultures from Carrière's case were made many years before it was known that pneumococci could be separated into biological groups, the attenuated strain that he isolated resembled the Group IV more than any other.

Wollstein and Meltzer (14) in their work on experimental pneumonia in dogs state

The intrabronchial insufflation of a non virulent pneumococcus causes like the insufflation of a virulent pneumococcus the development of an exudate in the lungs which in general leaves the

framework unaffected and the lesion presents the gross appearance of a lobar pneumonia. It differs however materially from the pneumonia produced by virulent pneumococci in the important points that the consolidation tends to a more rapid resolution, the disease is non fatal, the blood is not invaded by the organism and the exudate is strikingly poor in fibrin.

The published autopsy reports on postoperative pneumonitis are scarce and with one or two exceptions are based upon inaccurate observations. It must be remembered that the majority of such surgical cases die of some other complication such as sepsis, cachexia or uræmia and in these cases the pneumonia is of the septic hypostatic or gangrenous type — a terminal pneumonia. For this reason the few reliable postmortem studies on postoperative pneumonitis give not only a partial but an erroneous idea of the lesions of the complication as a whole.

Thus Henle (6) reports 52 autopsies in 65 deaths in a series of 143 surgical pneumonias. These occurred in a series of 1787 coeliotomies in von Mikulicz's clinic, the majority of them in connection with severe operations such as stomach resection. The resume of his autopsy findings is as follows:

Seven lobar pneumonias in various stages of hepatization

Twenty three lobular pneumonias 10 double — right and left side 7 right 6 left

Seventeen gangrenous 1 double 2 left 3 right

Five embolic

The interesting features in this series are the relatively few lobar and embolic and the large number of gangrenous pneumonias. In the average series with a pneumonitis complicating many operations for hernia repair and chronic appendicitis gangrenous pneumonia is exceedingly rare.

In the Presbyterian Hospital series there were 5 deaths with 7 autopsies. The findings were as follows:

Three lobar 1 entire left lung 1 entire right lung 1 right lower lobe

Four lobular

None of the cases coming to autopsy showed an embolic pneumonia.

Many surgeons consider the majority of

postoperative pneumonias is embolic in origin. There is undoubtedly the embolic type but in the majority of cases especially in the most common type occurring in the first forty eight hours after operation embolism is not the etiological factor for it is very seldom seen before the fifth day after operation. Hinkle's (6) autopsy reports refute the embolic theory and in our series the fact that the majority of the pneumonias occurred within the first forty eight hours and showed no rusty sputum at any time is strong evidence that embolism played no part in the process in these cases.

MORTALITY

Mortality in surgical pneumonia must be considered from two standpoints first the mortality in cases in which it is present as one of several complications and secondly the mortality in patient previously well where it is the only complication. The mortality in cases where it is one of several complications such as hemorrhage sepsis etc. when old age is high. Hinkle (6) reports 6 deaths in 143 patients having pneumonia following craniotomy a percentage of 4.5. Many of these cases were carcinomatous and or in great shock following extensive resection of the stomach. In this series of 97 cases the mortality was 25 or 25.7 per cent. This included many terminal septic and several embolic cases. Where the pneumonia appears in a patient who previous to operation was in good health and where it is the only major complication the mortality is fortunately low. In our series there were 61 pneumonias of this type with 9 deaths. But even one such death in any hospital crisis is a calamity and one not easily forgotten by relatives or by the surgeon. To have a patient in the prime of life and good health come into the hospital for an operation of choice and die of a postoperative pneumonia is one of the reasons for the dread the lady has for matters surgical. The fatal cases are usually the Groups I, II or III pneumonias or the embolic pneumonias. The Group IV is a relatively mild form of pneumonia. The influenza pneumonias are usually serious and very protracted.

SEQUELÆ

Aside from its mortality pneumonia is a serious complication for the following reasons.

First it delays the convalescence in many patients either because of the lung infection or more frequently because of the cough which may persist for weeks. Especially is this true of the influenza pneumonias. In one of the Presbyterian Hospital series the cough following an influenza pneumonia persisted for several months resulting in bronchiectasis. Secondly the cough usually associated with the surgical pneumonias and at times severe during the week following operation results in spreading of the abdominal incision and finally in a postoperative hernia. In five of the Presbyterian Hospital series the patients had marked ventral hernias necessitating later operation. When one considers the economic loss to a laboring man in some cases a year's time—the seriousness of the pneumonia sociologically becomes apparent.

SYMPTOMATOLOGY

In only very few so called surgical pneumonias is there the typical onset, fastigium and resolution by crisis of the usual croupous pneumonia. In the majority of our series there was no initial chill, no rusty sputum, no maintained high temperature for five to seven days, no severe toxæmia or alarming symptoms terminating by crisis. From the analysis chart it will be seen that postoperative pneumonia differs decidedly from the well known croupous or lobar pneumonia. As a rule the surgical type begins within the first forty eight hours after operation. The initial symptoms are sharp rise in temperature to 101 to 104, cough and increased respiration rate and pain in the side of the chest. At this time physical signs are usually dullness over a part of one of the lower lobes posteriorly but bronchial voice and breathing as a rule do not appear for another twenty four to forty eight hours. The radiogram taken at this time usually shows a shadow in one of the lower lobes often wedge shaped. During the next twenty four hours the temperature begins to fall by lysis and the case is usually considered one of postoperative reaction.

At this time however physical signs are those of lobular consolidation, the radiogram gives a definite corresponding shadow and the patient has a more or less severe cough with some expectoration but not rusty sputum. These symptoms subside gradually with the fall of temperature by lysis and there are as a rule no alarming respiratory or circulatory symptoms. Physical signs of lobar or lobular engorgement or consolidation usually persist after the patient's acute symptoms of temperature cough and pain have subsided. Serial radiograms taken during this period show fading shadows in the lobe involved.

The usual symptomatology described above is characteristic of the Group IV pneumonitis. In the Groups I, II and III pneumonitis symptoms are usually more severe especially did we find this to be the case in the Group I cases. These had the typical syndrome of croupous pneumonia.

In many of the Group IV cases the cough was severe and in the influenza pneumonitis very persistent. Pleuritic pain was not severe in the majority of our cases. Abdominal distention in several cases increased the dyspnea and cyanosis.

For a resume of the physical signs and radiographic findings the reader is referred to the accompanying analysis chart (Table V). It will be seen that the lesion occurs most frequently in the lower lobes especially on the right side. The radiogram of an injected bronchial tree may explain this frequency of involvement of the right lower lobe. The bronchi are wider, dip more vertically and the bronchioles are more numerous than on the left side (Fig. 2). Lillenthal (21) emphasizes the more frequent occurrence of lung abscess in the right lower lobe and Wessler () has reported a series of eight cases of lung suppuration following tonsillectomy, six of which the right lung was affected.

The radiographic method of studying postoperative pneumonitis has not been described so far as the writer is aware. Certainly for the purpose of early diagnosis and explanation of unexpected postoperative temperature this method has proved of great

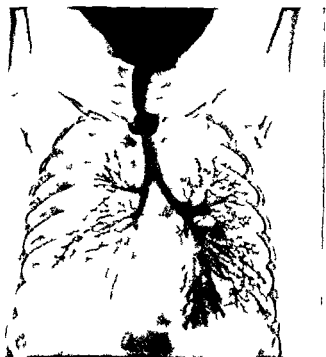


FIG. 2. Bronchial tree injected through bronchoscope. Roentgenogram by Dr. L. T. LeWald. Right bronchus incompletely injected because of consolidation. Note the more vertical dip of the right bronchus.

value in our series. In 11 cases the shadow appeared before any physical signs of consolidation were elicited either by the surgeons or by the medical consultants.

The presence of a shadow in the radiogram before the appearance of physical signs of consolidation has been noted especially in children. Weill and Mouriquand (23) from a series of 350 cases conclude that the shadow frequently appears before physical signs can be elicited and that the early shadow is usually triangular or wedge shaped with its base always peripheral that is parallel and involving some one of the pleural surfaces. Mason (4) in a series of 37 cases studied at the Presbyterian Hospital the majority of which were Group IV pneumonitis found similar shadows. In many of these cases the shadows appeared before any signs of consolidation. These early shadows are triangular in shape with the bases on the pleura and their apices separated from the region of the hilum by normal lung. Mason concludes that in their later development the shadows extend in size and become uniform from periphery to the root of the lung and that when the shadow involves this entire



I k 3 Ca A right ip l l m f f d v d at th p t lly bject sympt ms
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 Th s d ntg k m t k t l f t l f l l l l s t h l

stretch bronchial voice and breathing appear and not otherwise. He believes that in children at least a central pneumonia never occurs is such that silent pneumonias are subpleural consolidations and are separated from the hilum by normal lung, that bronchial breath and voice sounds are dependent on the presence of a medium of comparatively uniform density from the site of their origin (the trachea and large bronchi) to the point where the ear or stethoscope is applied. These conditions are fulfilled he contends when the consolidated area extends from just beneath the ear to the region of the hilum.

PREVENTION

Prophylaxis is even more important in postoperative pneumonia than in the so called medical pneumonia because it can be more readily accomplished. Prevention consists in eliminating as far as possible or combating where elimination is impossible the predisposing factors in the etiology of the complication. The two outstanding predisposing factors are first an inflamed condition of the upper respiratory tract second a congestion of the pulmonary blood vessels during and following the operation. The

following measures are at present being used at the Presbyterian Hospital and are being carefully checked by means of analysis charts to determine their relative value.

To avoid the first factor

1. In every case a special effort is being made to elicit a history of a recent or con-

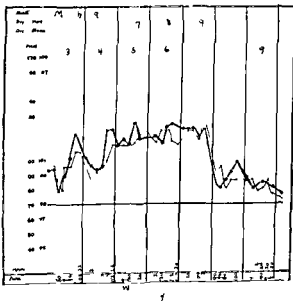


Fig 4 1 l l t m p t l t C

current rhinitis, coryza, tonsillitis, laryngitis or bronchitis and to check up the history by a careful examination of the respiratory tract. Except in cases of real emergency patients giving such a history or showing physical signs of an inflamed respiratory mucosa are urged to wait for at least a week after all evidence of such infection has disappeared before coming to operation.

Care is exercised in the choice of the anæsthetic and in its administration. This is especially true in patients giving the history of a recent or concurrent cold but where operation is necessary. In such cases depending upon the age, type of physique and general condition either gas oxygen chloroform or local anæsthesia is used. Ether should never be used in cases giving a history or signs of respiratory inflammatory lesions. Great care is used in the sterilization of an æsthesia apparatus. Every metal part is boiled between cases and rubber parts are sterilized with bichloride solution or lysol solution. It is very important to use the best ether, chloroform and nitrous oxide and oxygen. Ether and chloroform that have once been opened for one case should not be put aside for later anæsthesias. Of course



Fig. 5. Case. A fatal case of Group I pneumonia following operation for chronic appendicitis. Both sputum and blood cultures showed the Group I. The roentgenogram was taken on the second day after operation and showed a shadow in the right upper lobe before signs of consolidation were made out.

chloroform should be served from brown bottles.

3. Definite measures are taken to avoid exposure of the patient before, during and

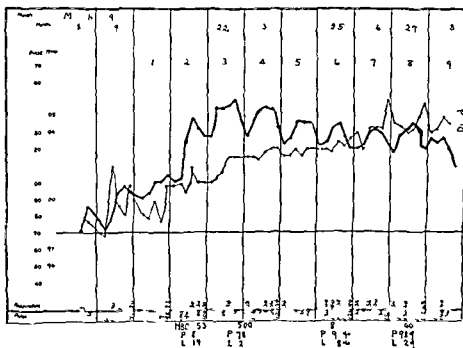
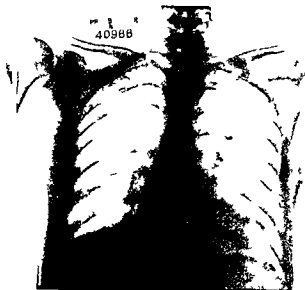


Fig. 6. Pulse and temperature chart. Case 2.

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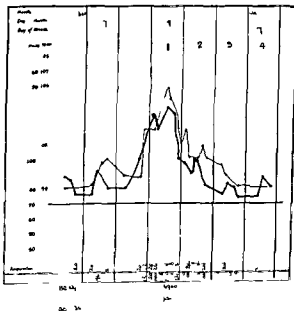
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g. Protection of the patient from draught and cold temperature during examinations
 h. The bath room are kept at a temperature of not less than 70° F. Morning and afternoon temperatures of the room are taken and reported by the nurse in charge
 i. All patients are put to bed immediately after the bath and are kept there until the next morning. In the case of a woman the hair is dried with a blower after the shampoo
 j. The pre-operative preparations and enemas are given with the patient in bed. They are not allowed to go to the lavatory during the afternoon and night before operation
 k. The male patient are given bed jacket the female short kimono both made of a woolen blanket material to be worn while in the Fowler or Crutch position and while sitting up in the ward. These garments are definitely more protective than the usual blanket or bath robe
 l. The stretcher which is used for the transportation of the patient to any part of the building is covered with blankets so

that when folded over him no part of the patient is unprotected

Kau ch (7) states that the incidence of pneumonia in von Mikulicz's clinic fell from 9 to 1 per cent in four years by taking pains to prevent the chilling of the patient



1. S. T. M. J. t. i. p. l. h. t. C.



FIG. 9 Case 4. A two day pneumonia following hernia repair. Gas-oxygen was used because of an accompanying coryza. The first roentgenogram (at left) was taken the second day showed the shadow before signs of consolidation appeared. Note the wedge shaped shadow. The second roentgenogram taken on the third day after operation showed a disappearing wedge-shaped shadow. Sputum culture showed Group III. Blood culture was sterile.

in the scrub up and in the operating room, to prevent aspiration of vomitus and mucus and by postoperative deep breathing exercises.

To avoid the second factor the so called pulmonary congestion two measures are being tried. In one ward every patient is given preliminary doses of tincture of digitalis $m\ X\ q\ 4\ h$ while awake during the 36

hours of his stay in the hospital preceding operation or until he is operated upon if less than 36 hours intervenes. The purpose of this measure is to get digitalis action at the time of and for a few hours following operation to combat the weakened heart action present in many cases during and 4 hours after operation. In another ward counter irritation to the chest anteriorly and posteriorly by means of a mixture of camphorated oil three parts and turpentine one part applied as soon as the patient reaches the ward is being tried in every case where dressings permit. Counter irritation to counteract pulmonary congestion has been used for several years in the Joseph Price Hospital of Philadelphia by Dr. Kennedy. He (25) claims most remarkable results from the use of a mustard paste immediately after operation. The mixture we are using is an active rubefacient but does not carry with it the danger of blistering or burning the skin of the patient who is not unfrequently unconscious. At the present writing the counter irritation seems to be a more effective preventive measure than the administration of digitalis.

ACTIVE TREATMENT

This differs in the two types of pneumonia that one sees after operation. In the pneu-

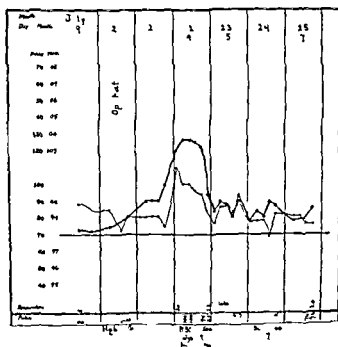


FIG. 10. Temperature chart Case 4.

Lungs clear Pharynx and tonsils red Operation third day Appendicectomy Anæsthetic Ether (Bennett apparatus) well taken Course See chart Fig 8 Sputum culture In pneumococcus Group IV Blood culture No growth Physical signs First day after operation dullness diminished breathing bronchial voice over right lower lobe Second day dullness slight bronchial voice disappeared Third day lungs clear (Fig 7)

CASE 4 L M age 16 history No 23043 Presbyterian Hospital History Congenital inguinal hernia coryza and pharyngitis for four days Operation Repair of hernia orchidopexy Anæsthetic Gas oxygen well taken Course On second day beginning signs of consolidation in right lower lobe Fourth day lungs clear Sputum Pure culture of pneumococcus mucosus no agglutination with Group I and II serum Blood culture Sterile (Figs 9 and 10)

The writer wishes to express his sincere appreciation to Professor George E. Brewer Director of the Surgical Service at the Presbyterian Hospital for the opportunity of reporting these cases to the attending medical and surgical and interne staff for their help and to Miss Marion P. Olmstead Resident Bacteriologist for her untiring work in cooperation in this study

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CHRONIC SURGICAL PROSTATITIS¹

BA B A THOMAS A M M D F A C S PHILADELPHIA

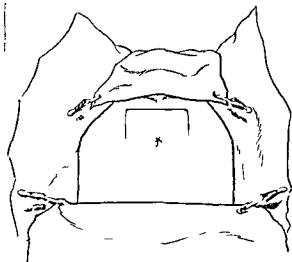
P f f G t ry S g ry th P l y l n H p t l d C l l f C d t M d

THE incidence of prostatitis as a common complication of gonorrhœa its frequent association with spermato cystitis the prevalence of mixed infection the disappearance of the gonococcus and the perpetuation of the disease by other pathogenic bacteria the complex and obstinate symptomatology the guarded and often gloomy prognosis due to the refractory nature of the affliction and its proclivity to recrudescences on the suspension of treatment and the morbidity of the disease are facts too well known to this audience to justify narration

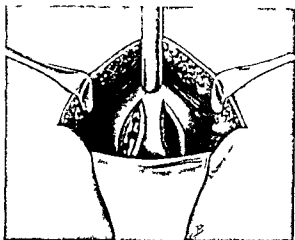
The objects of this communication are to record certain noteworthy observations on

cases of chronic prostatitis treated during the past year and to offer a plea in behalf of operative treatment for definitely selected types of this disease

There are very few textbooks on urological diseases that even mention the propriety of surgical intervention in the treatment of chronic prostatitis much less its necessity if we would permanently relieve or actually cure a small percentage of these troublesome cases Obviously neither prostatic abscess nor acute or subacute parenchymatous prostatitis characterized by military abscesses for which Alexander (6) recommended and performed prostatectomy should be included in this surgical group It is alleged



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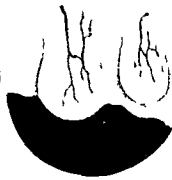
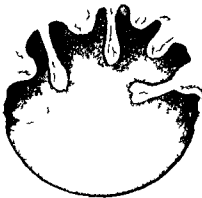
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that prostatectomy for chronic pro tatitis was first reported by Albarran (1) in 1900 although I have been unable to confirm the statement Since then Lel ur (2) Goebell (3) Zuckerkandl (4) and Young (5) have performed this operation with brilliant re sults

It is emphasized and will be remembered that the average case of chronic prostatitis proceeds to a satisfactory recovery by virtue of the well known and time honored con servative therapeutic meureses and that prostatectomy should be reserved for tho e exceptional cases the symptoms pyogenic urinary or nervous of which fail to manifest satisfactory improvement under pillative

treatment I am inclined to believe how ever that not infrequently these case are temporized with and might be more effec tively handled surgically Certainly an ap preciation of the irreparable pathological tate of the prostate when chronically in flamed commonly leading to a progres ive tissue destruction and cicatricial contrac ture permits of grave doubts as to the po sibility of normal tissue re titution In deed there is just about as much hope of this as there is expectation of cellular re covery in suppurative pancreatitis

Aside from a negligible mortality rate the factors instrumental in re training sur geons from prostatectomizing the e cases more



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extensively may have been the possibility of resultant sterility and impotence — consequences of some moment to a young man. Sterility should not be accorded too serious consideration since many of these patients are already sterile owing to their long standing and oftentimes repeated venereal infection. The wife of one of the four cases of prostatectomy for chronic prostatitis reported by Young Geraghty and Stevens subsequently bore a child. Likewise impotence is not infrequently a sequel of progressive obdurate prostatitis and therefore no contra indication to a well performed perineal prostatectomy. Moreover sociologically in some of these cases of chronic pyogenic prostatitis the future holds in store for the prospective wife a worse fate than impotency of the male. Irrespective of the above mentioned sequellæ there are certain cases of the urinary and nervous types in which surgical intervention is imperative and no hesitancy need be felt relative to minor undesirable operative results.

In addition to the usual chronic diffuse and nodular forms of this affection characterized by pus in the prostatic secretion and the presence or absence of various pathogenic bacteria not to mention the harassing urinary and neurological phenomena experience recently has revealed to me a necrotic type unassociated with any palpable enlargement, asymmetry or abnormal tenderness of the gland. Illustrative of this form of chronic prostatitis for which apparently prostatectomy has been followed by remarkable results the appended case history is submitted.

B F B aged 57 referred by L M Allyn Mystic Connecticut was admitted to the Polyclinic Hospital October 17 1916 with the following history. The patient denies venereal disease but states that during an attack of measles at the age of 32 he had complete retention of urine requiring catheterization and presumes that he was infected at this time. In any event 19 years ago he was the victim of epididymitis with pyuria and three years later first noted a stinging sensation at the end of the penis most marked just before urination. Four years prior to admission the patient's symptoms became more aggravated and constant he was unable to empty his bladder completely frequency developed then retention at times and he began

to catheterize himself. The family and previous medical history were essentially negative. In spite of urinary antiseptics by his local physician his symptoms grew irregularly worse and three years ago he was referred for cystoscopy. Urinalysis revealed much pus calcium oxalate crystals an occasional erythrocyte and a faint trace of albumin. The prostatic secretion contained a few extra cellular cocci and bacilli. The patient was 12 pounds under weight he felt tired and depressed but his organic condition generally was excellent. All blood tests were negative. At this time the prostatic right lobe *per rectum* felt a little larger and boggy than the left and slightly larger than normal a nodule of the left lobe was tender. The cystoscope showed a diverticulum one centimeter in diameter on the left lateral wall of the bladder. This also the trigonum and vesical sphincter demonstrated a state of chronic inflammation. The posterior urethra exhibited a low grade inflammation. A diagnosis of chronic prostatitis cystitis and diverticulitis was made and the patient was sent home with instructions for urinary antiseptics massage and total irrigations.

Periods of temporary improvement in health were followed by frequent recurrences of previous symptoms steadily becoming more aggravated. During the past year frequency and urgency have been present every one to one and one half hours by day and three times at night. Vesical tenesmus and stranguary have been excruciating and moreover intensified by the repeated catheterizations which the patient was obliged to perform. When the desire to urinate occurred he suffered the greatest agony sometimes writhing in almost unbearable torture on the bed clutching his genitalia in despair. Melancholia was mingled with desperation and on more than one occasion he was suspected of suicidal intentions.

At the time of his admission to the Polyclinic cystoscopy showed the cystitis and diverticulitis to have subsided. The prostate was normal in size symmetrical and not abnormally sensitive.

The index of elimination of indigocarmine was found to be in the positive phase namely 15 indicating a satisfactory functional state of the kidneys and in desperation with little expectation of finding much wrong with the prostate and therefore little hope of materially benefiting the patient as a last resort perineal prostatectomy was advised and performed October 8 1916. Aside from the usual rectangular perineal incision employed by the author (Fig 1) the technique for conservative prostatectomy so well described and practiced by Hugh Young was followed. Bilateral incisions into both lobes of the gland which externally appeared quite normal revealed on the left a dark brownish mass of soft juicy consistency obviously in a state of advanced necrosis on the right the normal prostatic tissue was studded by three or four pea sized necrotic foci similar to the diseased tissue of the left side (Fig 2). The small lobes were readily

enucleated or erased the vesical orifice forcibly dilated digitally a drainage tube placed in the bladder the lobe cavities packed the perineum repaired and the wound closed. The tubular drain was removed in two days the packing on the fourth day and the cutaneous sutures on the sixth day. The patient was out of bed on the fourth day. He passed some urine *per urethram* on the fifth day and all urine naturally on the ninth day. He walked to the bath room also on this date and allowed to return home on the eighteenth day. At the time of his discharge this patient was urinating with normal frequency and with absolutely no discomfort for the first time in many years. He sent advices from Lima stating that he continues to be free of urinary difficulties.

Aside from Alexander's acute or subacute parenchymatous cases with small abscesses and Young's chronic interstitial or parenchymatous cases with the usual cellular infiltration associated with cicatricial changes and more or less suppuration epithelial desquamation and distention of the acini and closure of the ducts there is no description of the precise pathological state found in the few cases of prostatitis for which prostatectomy has been performed. Therefore the case described by the author and characterized by a definite necrotic condition of the chronically inflamed prostatic tissue is unique from the pathological standpoint and merits report aside from the excellent clinical result obtained by prostatectomy.

The second type of chronic prostatitis in which surgical measures seem to be required for a complete cure and to which attention may be appropriately directed are those cases of long duration characterized by definite hyperplastic polypoid cystic or papillomatous changes of the mucous membrane of the posterior urethra and vesical orifice or by papules or nodules occasioned by prostatic or periprostatic inflammation involving the submucosa and mucosa. These small tumors are frequently multiple they are a cause for and aggravate urinary symptoms and by virtue of this common association with chronic prostatitis in the opinion of the writer may be relegated to this disease in explanation of their origin. Such patients on posterior urethroscopy exhibit definite tissue changes as above described and demand in conjunction with or subsequently

to the treatment of their prostatic certain intra urethral procedures of a surgical nature of which fulguration or high frequency sparking promises to be the best and has been attended by excellent results in three cases the brief histories of which are submitted.

J. G. R. aged 50 as referred by C. C. Corson of Germantown November 9, 1913, complaining of frequent urination night and day for years. He admitted having two attacks of gonorrhea 20 years ago. The first urine as clear but contained several suspended flocculi after prostatic massage it appeared cloudy and the microscopic field was loaded with pus. On palpation the left lobe of the prostate was slightly enlarged the right normal a cue for a tender nodule the size of a buckshot at the base of the gland could not be well defined. The cysto urethral scope accurately measured 10 cubic centimeters of residual urine and displayed at the vesical orifice anteriorly four or five soft nodules projecting from the mucosa (Fig.).

It was decided for treatment by electrolysis. Four treatments with Olden's electric park at weekly intervals sufficed to accomplish the result after which massage irrigations dilatations and other antiprostatic measures practiced for nine months were rewarded by an apparent cure.

I. R. aged 40 as referred by A. B. Hirsh on June 3, 1916 complaining of a thread in the urine. He had experienced several attacks of gonorrhea the first 20 years and the last years ago. His symptoms dated back to 20 years and were complicated by permanent ejaculations preventing marriage. Three years ago he was treated for gonorrhea by gonorrhea specialists and for the last six months had been treated by electrolysis. The urine contained shreds loaded with pus cells. Prostatic palpation felt normal in size though slightly soft and infiltrated over the right basal angle. Cysto urethroscopy demonstrated a few soft nodules and polyps from the vesical sphincter a teriole projected into the urethra (Fig. 4). Treatment by fulguration completely cleared the vesical orifice of the growths and nodules. Subsequent massage irrigations and topical application of silver nitrate to three months entitled the patient to a clean bill of health.

G. B. aged 27 as referred to the Genit. Urinary Department of the Holy Family Hospital on March 9, 1917 by Dr. Frank Hau of Coatesville, Pennsylvania. The patient had been afflicted with a urethral discharge for three years associated with a morning drop of pus and some frequency of urination. Rectal examination showed the prostate to be normal on palpation but slight infiltration in the region of the left seminal vesicle and definite induration of the gland. Cysto urethroscopy revealed a large adenoid nodule

smaller polypoid cystic or inflammatory formations situated in the prostatic urethra (Fig 5) also an enlarged and chronically inflamed colliculus seminalis with considerable congestion and inflammation of the posterior urethra. Two treatments by the high frequency spark have destroyed at least half of these tumors. The patient is still under treatment but already admits improvement in his condition.

In reviewing this subject in the light of the above case reports the following points in the treatment of chronic prostatitis stand out conspicuously:

1. Chronic prostatitis may be and is at times a surgical disease requiring prostatectomy for its most efficient treatment.

Chronic prostatitis is not infrequently associated with hyperplastic polypoid papillary or nodular formations of the mucosa of the prostatic urethra and vesical orifice demanding removal by treatment coincident with that directed to the prostate.

3. Fulguration or the high frequency spark promises to offer the best method of intra-urethral treatment for this purpose.

4. In protracted cases of chronic prostatitis cysto-urethroscopy is always indicated and may be obligatory for proper diagnosis and treatment.

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SOME OBSERVATIONS ON MILITARY SURGERY DURING ONE YEAR'S SERVICE IN THE 23RD GENERAL HOSPITAL, B E T, FRANCE¹

By JAMES M. NEFT, M.D. (C.S.) AND HON. LIEUT. COL. K. A. M.C. AND JOHN G. O'MALLEY, M.D. (C.S.) AND HON. LIEUT. P. A. M.C. CHICAGO

IN the few remarks which we have to make it is our intention to point out only some of the more important facts in military surgery which were impressed upon our minds during one year's service with the British Army in France.

To begin. Let us make it clear that there is no essential difference between military and civil practice. In other words the same fundamental principles that govern the one govern the other. However the types of injury which occur, the infection complications and the conditions under which the wounds must be treated present certain unusual aspects which may be roughly tabulated as follows:

1. In military practice the steel-jacketed or copper-sharp-pointed bullet is used exclusively.

In military practice the bulk of the injuries are due to fragments of shrapnel or

high explosive casings which always carry in portions of clothing contaminated by soil richly impregnated with infective organisms.

2. Because of the intensive cultivation of the soil and consequent contamination of clothing the majority of the cases are infected.

4. In military practice the time between the receipt of injury and the first dressing may be considerable. The injured often lie between trenches or in the first dressing stations from one to three days before proper surgical treatment can be instituted thus permitting infection to gain great headway.

5. In military practice the normal resistance against infection and shock may be greatly lowered because of loss of sleep, insufficient and irregular nourishment, almost constant exposure, high nervous tension and

frequently excessive hæmorrhage before the men receive first aid

This covers in the main the important differences between military and civil practice

In what follows we make use of no statistics and mention few individual cases. We have not even made a careful study along any particular line but the points which we have to present are all based upon personal observations and to our mind are most important. We have not touched on the medical aspect at all but have confined ourselves almost entirely to gunshot wounds. Volumes have been and will be written on every phase of the subjects which we shall merely mention so we repeat that this short paper will only touch upon a few of the more fundamental principles of military surgery as developed in the present war. While elaborate and detailed works will be most valuable from the standpoint of statistics and the evolution of different methods of treatment etc. they are not so important at the present critical time as short concise articles embodying only essential features based upon personal observations extending over a sufficient period of time to justify conclusions.

Let us begin by giving an idea of how the wounded are cared for from the trenches down to the base hospitals in France and England. The only part of the line that we have visited and know anything about is the British salient at Y so we will take that as a typical example of the entire British front.

1. There are the first dressing stations in the following positions

a. In dug outs in the trenches

b. In the cellars of chateaux just behind the line. These cellars are rendered as nearly bomb proof as possible by means of earth works and sand bags

c. In the basements of some of the wrecked buildings at Y.

The British trenches are from 4 to 5 miles beyond Y on the three sides of the salient. In these first dressing stations only the necessary work is done. Active hæmorrhages are checked edges of wounds cleansed with alcohol and iodine dry cyanide of mercury dressings placed on the wounds and temporary splints applied to fractured limbs. The in-

jured men are brought here by stretcher bearers who go into the trenches and here they are kept until the ambulances from the field ambulance station arrive. The field ambulance hospital is at Y seven miles from Y through the opening in the salient and the ambulances from here evacuate the first dressing stations at Y three times in twenty-four hours in the morning at three o'clock again at noon and again in the evening. Of course during periods of great activity evacuations are much more frequent. The dressing stations in the trenches and just back of the line however are evacuated only at night because of the heavy shell and machine gun fire which is going on all day.

2. From the first dressing stations the men are taken to the field ambulance hospital at Y. Here all urgent operations are performed such as ligations to control active hæmorrhage necessary amputations urgent skull operations etc. Patients are kept here as short a time as possible from a few hours to one or two days.

3. From the field ambulance they are sent to the casualty clearing stations situated two miles distant at the rail heads. Here all necessary operations are performed that were not done at the field ambulance such as laparotomies for abdominal gunshot wounds decompressions amputations etc. Here too anti tetanic serum is given to every man with an open wound. It might not be out of place here to mention the excellent results that are being obtained in gunshot wounds of the abdomen in these hospitals. All cases are operated upon with 50 to 60 per cent recoveries. Patients remain in the casualty clearing stations from a few hours to a week or ten days except during periods of great activity when both field ambulance and casualty clearing hospitals are used as first aid stations.

4. From the casualty clearing stations the patients are transported in ambulance trains to the base hospitals in France. These are located from twenty to forty miles behind the line at three centers Boulogne Etaples and Rouen. In and around Etaples where our unit was stationed there were accommodations for 45 000. In these hospitals all

operations are done that were not performed at the field ambulance and casualty clearing stations. Here all shrapnel and bullets are accurately localized with the X-rays and removed and all operations are performed that will not necessitate the patients remaining in the hospital more than 3 or 4 weeks.

5 From the base hospitals in France the patients are sent either to the reinforcement camps for return to the line or to the permanent base hospitals in England. The cases sent to England include those which are permanently incapacitated and in which recovery will require longer than 3 or 4 weeks.

GENERAL CONSIDERATION OF WAR INJURIES

1 Practically all shrapnel and high explosive shell wounds are infected because—

1 Pieces of clothing are always carried into the tissues with the fragments of shell casing and

2 The rate of speed at which the fragments travel is relatively slow and therefore they with the pieces of clothing remain in the tissues. The only cases of shrapnel wounds not infected are those caused by small sharp pieces which penetrate but do not carry in foreign material.

B All bullet wounds are clean except in cases where the bone is shattered and the wound of exit is therefore large. They are clean because the bullets travel at a high rate of speed, make a small wound of entrance, a small wound of exit and carry no fragments of clothing with them.

C The wound of entrance and the wound of exit are always the same size except where the bullet has struck bone. In these cases the bullet may flatten, become deflected or fragments of bone be carried out, causing the wound of exit to be larger than that of entrance. Here the contact of tissue with infected clothing or soil renders infection possible.

Nothing definite has been learned as to the different effect of bullets fired at long or short range, though it is generally supposed that the bullet is steadiest in mid distance. It makes no difference as regards the wounds of entrance and exit whether the bullet is reversed

or fired point forward or whether it is of steel, nickel, lead or copper, provided it does not strike bone. If a lead bullet strikes bone it will naturally spread more than a steel-jacketed one, but through soft tissues there is no spreading action and the dreaded *dum dum* effect therefore does not exist. Shrapnel bullets travel only at the rate of speed of the shell which contains them and therefore are very likely to remain imbedded in the tissues.

D *Infection* The ordinary pus organism are responsible for most of the trouble in shrapnel wounds. The streptococcus, staphylococcus and the colon bacillus are most frequently found. The gas bacillus complicates many of the wounds caused by shrapnel casing for the simple reason that it is present in the soil and clothing and is therefore carried in with the fragments. It is almost certain, however, that it is always a secondary infection and never exists alone. The gas bacillus may be looked upon from a practical standpoint as a saprophytic organism which grows in the body only in tissue already killed by intense infection or injury and produces its peculiar effects within the tissues by distention and pressure from the gas formed. In other words it is probable that the gas bacillus, by distending and dissecting the tissues with gas, merely aids extension of the primary infection and renders its local action and absorption of its toxins more rapid and intense. It is also probable that the gangrene usually attributed to the gas bacillus is in reality due to the primary infection and that the bacillus is merely an accident producing its effects in the already dead tissues. We say this with the full knowledge that some pathologists have reported cases in which they claim to have isolated the bacillus from the blood of patients before death. We think these were cases of accidental contamination or terminal infection.

It is unnecessary to consider infection by the tetanus bacillus further than to state that it not infrequently complicates extensive injuries of the buttocks and wounds of the rectum and large intestines. This is true because the bacillus is a fecal organism and

in the above named injuries the field is contaminated by faces. Furthermore as this organism is ever present in the richly cultivated soil of Belgium and France it may be a complication of any condition in which the skin has been abraded and the superficial or deep lymphatics exposed. This is most strikingly illustrated in the cases of trench feet in which blebs form rupture and permit the invasion of the tetanus bacillus. We have in mind one such case in which death occurred.

Treatment of infected wounds. (1) All shrapnel and particles of clothing should be localized and removed as soon as possible. This is an invariable rule except in cases where the pieces of metal are very small without risk of removal and not associated with infection.

After removal of the shrapnel and fragments of clothing the wound cavity or infected area should be freely drained by means of fenestrated rubber tubes.

(2) All irrigations are superfluous and useless and should not be employed. Their use causes unnecessary suffering to the patient and they do absolutely no good except as a deodorant. So much has been written during the past year concerning the almost magical effects produced by sodium hypochlorite solutions upon infected wounds that we feel we should record our own observation.

In our hospital of fifteen hundred beds the surgical side was divided into three services for the first six months and into two for the last six months. During the year more than seven thousand surgical cases were treated. During the first six months the eusol treatment of wounds with intermittent irrigation through multiple drainage tubes was used entirely on service No. 1 in more than one half the cases on service No. 3 and in none of the cases on service No. 2. During the last six months it was used in nearly all cases on service No. 1 and in none on service No. 2. The surgical cases were equally divided between the different services thus we had ample opportunity of observing the effects of hypochlorous acid solutions in all varieties of infected wounds and to compare them with the results obtained by thorough and adequate drainage without irrigations of any

kind. The result of these observations is that we can say without hesitation that in not one single case did we observe any of the phenomenal results that have been recorded in the numerous articles above referred to. Furthermore we are firmly convinced that the old established treatment of incision and adequate drainage gives as good if not better results than are secured by irrigations of any kind.

It might be argued by the advocates of the Carrel Dakin method that we did not employ the treatment exactly according to the strict and rigid formula which has been laid down and that our failure to secure result was therefore due to the treatment being improperly used. In reply we must say that it is inconceivable for us to imagine that very slight variations in technique could produce such enormous variations in results. The eusol solution used was made after the published formula and in all cases multiple drainage tubes carried it into the deepest recesses of the wound also the irrigations were intermittent the solution being allowed to flow into the wound from a container fastened to the side of the bed. We cannot at this writing state the exact length or diameter of the tubes or the exact number of perforations but this is one of the minor differences of technique which should not produce enormous differences in results particularly in view of the fact that free chlorine is the active agent liberated when both hypochlorous acid and sodium hypochlorite come into contact with organic matter. In other words the effect of eusol and Dakin's solution should be exactly the same so far as the overcoming of infection is concerned.

Again we state that in not a single severely infected wound did we see any hastening in the process of healing that could be directly attributed to the use of the hypochlorous acid solution and after observing hundreds of compound comminuted infected fractures of the long bones treated with and without it we can say definitely that from our observations the solution enjoys only one place in the category of medicine that of a deodorant.

Now let us analyze briefly the technique of the Carrel Dakin method and see what is

claimed necessary in order to secure the marvelous results recorded

1 We are given to understand that the method must be used according to a definitely standardized formula. In the first place the solution must be carefully made so that it will be free from alkali and contain not more than 0.5 and not less than 0.45 per cent of sodium hypochlorite. Now if there is the slightest alkalinity or if the solution contains 0.51 per cent or 0.449 per cent of sodium hypochlorite the results may not be obtained.

2 It is emphasized that all those that are to use the Carrel Dakin method must have at least two weeks training in a hospital where the method is correctly employed. If such training has not been had there is a loop hole for escape in case of failure.

3 An apparatus of special design must be used if one is to secure results. If the apparatus varies even slightly from this design the failure which may result is the fault of the surgeon and not the treatment.

4 The *foci* of infection must be reached by the solution and in any case where it is impossible to demonstrate that this has been done—and there must be many—no one can say that the method is to blame if results are not obtained.

5 In order to secure the marvellous results reported treatment should be begun within 4 or 36 hours from receipt of injury. Now in active service at the front this is impossible in the majority of cases and the failure to secure sterilization of the wounds can therefore not be laid at the door of the Carrel Dakin method.

6 All necrotic tissue and all foreign bodies must be removed before the treatment is started. Now as localization of foreign bodies by the X rays is possible in only a small percentage of cases within 36 hours no special form of treatment can be held responsible if results are not obtained.

7 The solution which should penetrate all diverticula of the wound must be renewed every two hours and only a sufficient quantity used to fill the wound without overflowing. If these instructions are not carefully followed no one can say that the method has failed.

8 The definite statement is made that when only one bacterium is present in five fields with a one-twelfth oil immersion objective suture of the wound may be carried out and will be followed by primary union. If however there is one bacterium to two of three field failure will probably result. This to us is absurd.

9 The rubber tubes must be 5 mm in diameter in the lumen of 3 mm with a 1 mm wall also they must be of pure rubber and perforated from six to twelve times on four sides with a special punch. These conditions are essential to the treatment and must be adhered to if good results are to be secured.

10 The tubes must penetrate into every crevice of the wound so that every square millimeter of wound surface must be constantly bathed with the

solution. Of course it is obviously impossible to prove that this has been done in any given case but it is one of the requirements which must be fulfilled.

11 Strips of gauze must be packed loosely between the tubes which are from 15 to 25 cm long and should never be packed tightly in the wound. If because of swelling of the wound the gauze should be found to be tightly packed at redressing failure may result.

It is useless for us to continue an enumeration of the many things that must be done in a very particular manner in order to secure the desired results but we have mentioned a sufficient number to demonstrate the difficulties encountered in following out the standardized formula. They are so numerous that it is perfectly safe to say that if they were all carried out a complete sterilization of the wound might be obtained.

The sterilization of a septic wound by means of any solution seems to us in the light of our experience too absurd even to consider seriously. The statement is made that the bacteria on the surface will rapidly disappear and no doubt this is true for they are being constantly washed away by the repeated two hour irrigations. This would naturally be the case with any fluid used in the same way be it sterile water or sodium hypochlorite solution therefore the number of bacteria on the surface of the wound cannot possibly be an index to the degree of infection in the tissues. Everything considered we must conclude that the Carrel Dakin method is nothing more or less than adequate drainage of the wound with irrigation by an antiseptic solution. Now many prominent surgeons have demonstrated in their own experience many years ago that all irrigations of infected wounds were useless and this is as true today as it was then.

Since we have been so unfortunate as to be unable to secure results with the use of any antiseptic solution in infected wounds it would seem proper to inquire into the reasons for our failure. These to us are perfectly obvious.

In the first place all antiseptic irrigations affect only the pathogenic organisms on the surface of the wound with which they come in contact. It makes no difference whether there be one or one hundred tubes inserted in

an infected area it still resolves itself into a partial disinfection of the surfaces which are in contact with the tubes. In other words all solutions are absolutely powerless to affect pathogenic organisms which are present beneath the surface and it is these organisms that are doing the damage.

All micro organisms on the surface of an infected wound are harmless and are of no consequence for the simple reason that they have been thrown out of the tissues by the exuding serum. To kill and wash these away obviously does no good. The reason why we are unable to penetrate tissue with antiseptic solution is perfectly plain. Within the tissues there is always a plus pressure in both the blood and lymphatic vessels in relation to the surface of the wound. This means that the flow of serum is always outward toward the surface which makes it as impossible for any solution to enter as it is for water to flow up hill. To be sure certain chemicals are absorbed but they are absorbed by the superficial lymphatic vessels only and do not enter the intervacular spaces. These few simple and obvious facts explain the failure of all irrigations.

Most extravagant claims have been made by many surgeons as to the miraculous results obtained by the Carrel Dakin method for instance one claims that 99 per cent of the wounds treated by him according to this method have healed by primary union another that in 80 cases of compound fractures not one suppurated. Still another states that the method is an absolute specific in all cases of infected wounds and therefore we are led to believe that we are masters of infection. In the light of our experience we cannot believe these statements though we do not question that those who made them were honest in their convictions. Yet there is no question but that better work is being done in the first dressing stations and base hospitals at the present time than during the first year of the war. More lives are saved fewer amputations are done and more men are being returned to the line in a shorter period of time. We believe that this is due to the fact that we have learned by experience how better to deal with war injuries. Moreover the mili-

tary hospitals have become better organized the elements of excitement and newness have subsided and the entire business of caring for the wounded has settled into a well regulated and well conducted organization. We believe that the better work which is done now is due to these conditions and not to any revolutionary methods which have been evolved for the treatment of injuries.

4 Hot wet dressings are useful in relieving pain and facilitating drainage by preventing the drying of discharges. Hot water answers the purpose as well as any solution.

5 Vaccine treatment for infected wounds in the base hospitals is of little value because the cases are all acute and do not remain long enough for beneficial results to be secured.

6 In military practice all bullets should be removed unless their removal is attended by danger to life. Here military practice differs from civil because in the former the object is to return all men to the front as soon as possible and no man will go back so long as he knows there is a bullet in his body. Therefore for all bullets should be removed.

There are a few points on injuries of different parts of the body which were forcibly impressed upon us during our service and which we feel should be recorded. There is no attempt at completeness in the consideration of these injuries and only the more common ones are mentioned. The few that are presented however are of the utmost importance. When we speak of gunshot wounds we mean injuries produced by shrapnel and high explosive casings rifle bullets and shrapnel balls.

The head. All bullet and shrapnel wounds of the head should be operated on unless it is perfectly clear that the skull is uninjured. This is necessary because of the fact that pieces of the cap or helmet are usually carried in and especially in the case of shrapnel wounds fragments of the inner and to a lesser extent the outer table are driven into the brain. In bullet and small shrapnel wounds the operation should consist of first cutting away and cleansing the margins of the wound itself and then turning down a horse shoe shaped flap of the scalp including the periosteum with the wound in the center. This

gives a perfect exposure of the injury in the skull which should be enlarged with rongeur forceps as much as is necessary and any foreign material depressed fragments of bone and necrotic brain tissue carefully removed. A small drain should always be inserted through an angle of the incision for 24 or 48 hours depending upon the nature of the wound. Larger shrapnel wounds should be enlarged the edges cut away and treated in the same manner. In all cases roentgenograms should be taken and any pieces of shrapnel or bullets carefully localized. It is not advisable to attempt to remove shrapnel or bullets from the brain unless they are accurately localized near the surface and easily accessible because much more harm than good will be done. If the metal is located deep in the brain and signs of infection develop the best treatment is carefully to insert a tube of rubber aluminum or glass into the brain substance so that the end will be as near as possible to the metal. This tube should be allowed to remain in place until drainage is established and the conditions warrant its removal or further interference is indicated. In all cases the opening in the skull should be as small as possible. Large osteoperiosteocutaneous flaps should never be made for the simple reason that if much bone is removed in the presence of infection cerebral hernia and fungus cerebri are very likely to develop and prove fatal.

The results of decompression operations for the relief of intracranial pressure due to hæmorrhage from gunshot wounds are very unsatisfactory because the hæmorrhage is usually very extensive and the destruction of brain tissue great before the patient comes to operation. However if signs of paralysis of the basic centers have not begun operation should be performed always remembering to make the opening in the skull small and to cover it carefully with muscle and fascia.

The neck Gunshot wounds of the neck deserve special consideration only when they involve important structures such as the trachea pharynx œsophagus great vessels and nerves. If the trachea or larynx is injured extensive emphysema of the subcutaneous tissues and œdema of the glottis are

likely to result. The former should be treated by exposure and suture and the latter by tracheotomy if necessary. The greatest danger following injuries of the pharynx and œsophagus is cellulitis of the neck which frequently extends downward causing a fatal mediastinitis. Early and adequate drainage is indicated.

The great vessels are often injured by the sharp edges of shrapnel casing or small sharp pieces of metal contained within the shell which may partially or entirely cut through the vessel wall. In some cases immediate and fatal hæmorrhage takes place while in others the bleeding does not begin until the metal is removed when it is profuse and must be dealt with by suture or ligation. The brachial plexus is occasionally injured but not so often as one would suppose. We will say more on the subject of the blood vessels and nerves later.

The chest Bullet and shrapnel wounds of the chest may or may not involve the lung and may or may not cause hæmothorax and hæmoptosis. When hæmothorax is present the hæmorrhage usually comes from the lung and not from the vessels of the chest wall. Hæmoptosis usually means that the lung has been injured by the projectile but not in all cases as in some concussion may be responsible for the bleeding. Of the many cases of gunshot wounds of the chest which came under our observation not one died. In cases of hæmothorax after the active hæmorrhage has ceased it is good practice to aspirate from one fourth to one half the quantity of blood in the pleural cavity as this has been demonstrated to hasten absorption of the remainder and so prevent a permanent atelectasis of the compressed lung.

In cases where shrapnel is imbedded in the lung and cannot be removed with safety supuration usually develops around it and presents all the signs and symptoms of lung abscess. These cases are treated as any ordinary lung abscess except that it is usually possible at the time of operation to remove the foreign bodies which lie loose in the abscess cavity. Empyæma of the pleural cavity is a not unusual complication after hæmothorax. It is easily recognized and the indications for

treatment are clear. Occasionally gas bacillus infection further complicates an empyema and gives rise to rather characteristic signs and symptoms. These develop in cases of hæmorrhæ which were previously running little or no temperature. They are sudden rise of temperature to 104 or 105, great prostration, pallor and rapid pulse and respiration. A puritan shows a grayish foetid pus that may or may not be mixed with gas. Immediate drainage of the pleural cavity is imperative. The physical signs are those of a hæmopneumothorax and it is probably the presence of a large quantity of gas in the pleural cavity which causes the urgent symptom. We can say nothing of a gunshot wound of the heart as we saw only one case where there was a small piece of shrapnel imbedded in the heart wall and we did not have an opportunity to remove it.

The abdomen. Our experience with gunshot wounds of the abdomen was very limited as we had no fresh case and saw the patients only after they had been operated upon at the casualty clearing stations. As stated before the results obtained have been excellent from 50 to 60 per cent of those operated on recovering perforations of the small intestine show a higher mortality than those of the large for three reasons:

1. Because perforations of the small intestine are usually multiple while those of the large are single.

2. Because the fluid contents of the small intestine escape at once into the peritoneal cavity and

3. Because in the case of the large intestine adhesion to the anterior abdominal wall with fistula formation often takes place while this practically never occurs in the small. Early operation with suture or resection and drainage of the peritoneum is absolutely essential.

Gunshot wounds of the liver are always serious especially in the case of shrapnel which produces extensive laceration destruction of the liver substance and severe hæmorrhage. The missile may pass through the liver and lodge in the pancreas causing retroperitoneal suppuration and fat necrosis. Subphrenic abscess, pyelophlebitis and secondary hæmorrhage are among the serious

complications of gunshot wounds of the liver.

Bullet and shrapnel injuries of the bladder may be intra or extra peritoneal and should be treated accordingly the former by laparotomy with suture of the bladder wall and drainage the latter by free drainage of the perivesical tissue. In both the bladder itself should be continuously drained suprapubically, perineally or *per urethram* as may be indicated.

Rectum. In extensive wounds of the rectum early colostomy should always be performed preferably in the sigmoid or descending colon. This puts the rectum at rest and prevents the constant contamination of the field with feces. Later the rectal injury should be repaired if possible and the fistula closed.

Joints. In gunshot wounds of the joints the synovial membrane, cartilage and bone are always injured to a greater or less extent. In the case of bullet wounds without infection there is hæmorrhage in the joint cavity, great swelling and pain on motion. We refer now to the larger joints such as the knee, elbow, shoulder and hip. In these cases aspiration of the blood, rest and extension with passive and active motions as soon as conditions will permit are indicated. In shrapnel wounds infection and suppurative arthritis always occur and greatly endanger not only the joint and limb but also the life of the patient. Removal of the metal and fragments of clothing with adequate drainage at the earliest possible moment are indicated. In the case of the knee joint if the infection is severe it has been found good practice to open wide the joint cavity by turning up the patella in a flap, the horseshoe shaped incision extending around it with the pedicle above. The ligamentum patellæ is sutured to the skin on the anterior surface of the thigh and the limb is immobilized in extension by means of a posterior plaster of Paris splint. The joint is kept open in this manner until the infection has subsided when the patella is removed, the flap turned back into place and the joint allowed to ankylose. In the elbow the suppurative arthritis is usually associated with extensive comminution of the bones entering into the formation of the joint especially the

lower end of the humerus. Here it is often best to do a resection of the joint removing all the shattered fragments and then maintain efficient drainage. When the infection has subsided and two or three months after the wound has healed a bone transplantation should be performed. The methods of resection with wide open drainage are sometimes necessary in the shoulder, hip and wrist but in a smaller percentage of cases. We do not mean to advocate these radical measures in all cases of suppurative arthritis but they should be resorted to when the infection is intense or persistent and before amputation is considered.

Infected compound fractures. Infected compound comminuted fractures of the long bones constitute one of the most difficult problems in military surgery today. After a year's experience in one of the busiest base hospitals in France we can say without hesitation that we have made very little progress in the treatment of these conditions. After we have removed the metal and fragments of clothing and instituted free drainage we have done all that can be done except to keep the limb in good position and wait until the infection subsides. Where there is extensive comminution and the infection is severe or very persistent it is often good practice to remove all fragments and saw the bone on squarely above and below. This leaves a cleaner cavity which heals more rapidly and the defect can be bridged across later by a bone transplantation. This method is used extensively by the French military surgeon, probably too extensively as the majority of cases will recover without it and of course with much better functional result.

The means of supporting the limb during the long period of immobilization which is required for healing in these cases is important. It is best accomplished by a modification of the Hodggen's splint applied as follows. One six foot upright at each end of the bed supports a horizontal beam running from head to foot. The uprights and beam may be shifted to either side of the bed as occasion demands. In the case of the femur a stout wire frame bent for the knee holds on each side the transverse sling of canvas

which support the limb. This splint containing the thigh and leg is suspended from the horizontal beam by means of cords attached to the middle and each end of the frame. These cords converge into one which runs over pulleys screwed into the under surface of the beam. A weight of 10 to 20 pounds attached to the end of the cord beyond the foot upright allows the limb to be raised or lowered when the patient moves. An ordinary Buck's extension attached to the leg and thigh below the site of fracture is used to overcome shortening and to keep the fragments in line. Exactly the same principle is applicable to the arm and forearm. The great advantage of this method is that the wound may be dressed easily without disturbing the patient merely by removing the canvas sling under the dressings and replacing it when through. Countertransverse and vertical extensions may be easily applied if indicated.

Amputations. One very important point has been brought out in this war and that is the advisability of early amputations in cases of very severe injury of the extremities with intense infection and violent systemic intoxication. In all cases where the infection is virulent and the future usefulness of the limb if saved is doubtful amputate. This applies particularly to gas infections and where there has been more than one secondary hemorrhage in a septic field. Such amputations should be performed high above the infected area, the work done as rapidly as possible, very little anæsthetic used and the stump left wide open. Never suture the flaps as the drainage will thereby be rendered less efficient and the sutures will invariably have to be removed. Unless the injury is low down in the leg it is best to amputate above the knee.

Spinal column. Gunshot wounds of the spine with irreparable injury of the cord are by no means uncommonly observed and are usually produced by bullets or shrapnel causing in the majority of cases such severe injury that death occurs before the patients reach the base hospitals. The bullets often lodge in the spinal canal and are removed by laminectomy. All such operations of which we have any knowledge have been absolute failures.

for the simple reason that the cord at the site of injury has been destroyed and therefore the removal of bullets or blood clots has been of no avail. However as the operation is not associated with great danger to life and the cases are hopeless without it it should continue to be performed in the hope that the cord has not been severed and that the paralysis is due to pressure only.

The blood vessels The larger blood vessels may be injured by bullets or shrapnel. In some cases a bullet may pass through a large artery like the superficial femoral without fatal hemorrhage taking place the vessel becoming occluded by clot formation on each side of the injury. In other cases arteriovenous aneurism develops or merely a traumatic aneurism of the artery at the site of injury. Very frequently the vessel wall is partly or wholly divided by the sharp edge of a piece of shrapnel and bleeding does not occur until the shrapnel is removed. In these cases the opening in the artery or vein must be closed by suture or the vessel ligated above and below. Blood vessel suture has played a very small rôle in the surgery of the present war for the reason that almost all the wounds are infected and as is well known no vessel can be successfully sutured in a septic field. We have been especially interested in this line of work for a number of years past and were constantly on the lookout for cases in which it could be used but in vain. Secondary hemorrhages are very common where the larger arteries have been ligated in a septic field and this is especially true in the case of gas infections for here the gas dissects the vessel free from all surrounding structures and consequently it loses all support. The danger of secondary hemorrhage from the large vessels increases enormously the nearer the ligation is to the heart because of the increase in the square surface against which the pressure acts. This constant pounding against the ligated septic vessel wall finally results in the cutting

through of the ligature and secondary hemorrhage. We have learned a very important point about secondary hemorrhage in infected fields and it is this. If secondary hemorrhage occurs more than once waste no time in further ligations but amputate immediately. If this rule is followed many lives will be saved.

Nerves Injury to the larger nerve trunks is not so common as might be supposed. They may be partly or completely divided by bullets or shrapnel they may become imbedded in scar tissue after injury to the surrounding structures they may be paralyzed by contusion or concussion as when the projectile passes close to them or lodges over them or the function may be lost by minute pieces of shrapnel becoming imbedded in their substance. We have observed many cases illustrating each of these injuries. The brachial plexus is most often injured because of its exposed position either in the trunk or the cords or the branches of distribution. The median ulnar and radial in the upper extremity and the sciatic common peroneal and popliteal nerves in the lower are also frequently injured. In all of these cases where organic lesions can be demonstrated to exist the wounds should be allowed to heal completely before an operation is performed. Where the nerve has been divided the operation consists of the resection of the bulbous ends with suture of the stumps. When the nerve has been imbedded in fibrous tissue it should be freed and surrounded by fat or muscle. Of the numerous nerve sutures which we performed none could be followed a sufficient length of time to ascertain the ultimate result.

This covers in a superficial manner the more important points which impressed us during our year's service. We have touched upon nothing that was not strictly military and have looked upon everything from the standpoint of active service in the field.

CYSTS OF THE HYPOPHYSIS¹

BY ALLEN B. KANAVEL, M.D., CHICAGO

WITH PATHOLOGICAL REPORT BY HARRY JACKSON, M.D., CHICAGO

CYSTS offer from a surgical standpoint the most satisfactory type of tumors of the hypophysis. Not only is the operation technically more simple but from a prognostic standpoint the results are superior to those we have been able to secure in the adenomata and other solid tumors in that the patients are restored to society as useful and self-sustaining members who may live out the natural span of life. This latter desideratum which should be the end and aim of all surgery has not always been demanded in cranial surgery. We too often announce operations as successful in patients who secure comparative physical well-being but who nevertheless remain charges on their relatives or public charity. The patients with hypophyseal cysts on the contrary recover both physical and mental properties but unfortunately do fail frequently to recover certain physiological functions in that the sexual phenomena and the processes of growth are commonly lost. One cannot but hope however that as knowledge concerning these cases becomes widespread we may be able to operate upon them earlier in life and it would seem reasonable to assume that if the cyst be treated before puberty these physiological functions may be preserved either through normal hypertrophy of the portion of the gland remaining or through the interrelation of the other ductless glands taking on its function.

Although we must admit that the function of the anterior and posterior lobes and the pars intermedia has not been settled beyond question yet the magnificent work of Cushing, Goettch and their associates, Lewis and a host of other able workers has in general ascribed growth to the anterior lobe while the change in kidney function, adiposity, etc., reside in the pars intermedia or the posterior lobe. Erdheim deserves great credit for bringing forcibly to our attention the fact that the cysts generally have their origin

in the anterior lobe or anlage of the primitive pharyngeal pouch. If these observations be true we would expect impairment of growth both from cellular destruction and cellular physiological perversion due to pressure the latter naturally being subject to recovery upon removal of the pressure due to the cyst. In like manner a recovery of the function of the pars intermedia and posterior lobe becomes possible. To secure the greatest benefit therefore it is necessary that the tumor should be removed before the onset of puberty with its probable cellular hypertrophy and certain physiological activity. Unfortunately our knowledge of the signs and symptoms of the disease is confined to the evidences of long continued perversion of function as well as primary destruction. We now recognize the disease by the picture presented some years after puberty just as for many years we recognized thyroid perversion by the ultimate exophthalmic sign, myocarditis and enlarged thyroid not by the toxic evidences of bruit over the gland, vasomotor instability and tachycardia which we now know precede the other evidences by many months and indeed can be prevented by early operation. So may we not hope that careful analysis of the histories given by these patients and careful observation on the part of each of us may elicit some symptom complex suggestive enough at least to demand X-ray studies of the sella turcica and through this lead to diagnosis? The development of symptoms about the time of puberty may be due to two factors: first the onset of the physiological processes above mentioned and second the changes in the cyst itself incident to secretory changes at this time of life. That the latter has considerable bearing on the case seems probable when we remember that in addition to the perversions of physiological processes noted in these glands the evidence of brain pressure begins to be marked a sign seldom seen before puberty.

The cysts probably grow from two causes increase of fluid — either by secretion from its wall or filtration from compressed veins — and from hemorrhage into the cyst. The latter is by no means an uncommon occurrence. In view of these general observations it follows that at puberty any child showing an absence of growth particularly if he has attacks of transitory blindness should be studied immediately for hypophyseal disease. Attacks of transitory blindness are noted in most of the histories of these cases. Many have rested for years under the diagnosis of hysteria made by able ophthalmologists. Whether these periods of blindness are due to hemorrhage into the cyst with subsequent absorption is open to question but that it frequently is the cause is my personal belief.

It is not to be doubted that such intensive study of these cases may lead to much new knowledge concerning infantilism in relation to hypophyseal physiology and a well to other glands of internal secretion possibly developing our diagnostic acumen to such a degree that we may be able to operate upon these cases before the perversion of physiological function of the cell has become permanent thus restoring these patients not only physically and mentally but also physiologically to their natural place in society.

It has been my fortune to operate upon three cysts of the hypophysis. Time enough has now elapsed to give some idea of the permanence of cure and the extent of the recovery. Of these two S. W. and R. B. have been reported previously the first by myself with a study of the final results of similar cases but in view of the interest in these cases and my other material and the time that has elapsed since that report I wish to draw attention to that case again. The second case was operated upon early in my experience and I regret to report ended fatally from a meningitis. I feel that had I the opportunity to operate upon her now with my added experience such a result would not have occurred. The third case R. B. was briefly reported in conjunction with a pathological study by Dr. Jackson² and is now

presented three years after the operation showing the ultimate result. The accompanying drawings by Mr. Tom Jones show the step of the operation I have used for a number of years. After the death of the second case here reported I added to the technique presented in my first contribution³ the submucous principle advocated by Hirsch.⁴ Otherwise I have not materially altered the procedure and added experience justifies the claim made previously of its comparative simplicity and its superiority over the Schloffer von Eiselsberg and other transphenoidal operation which preceded it all being executed through the superior part of the nose. Hirsch and Halstead have suggested modifications of the operation I proposed. The submucous retraction of Hirsch is a distinct addition and has been added to my technique and will be seen by examining the drawing. The Ellberg modification of McArthur procedure would seem to be one of the best of the extranasal procedure and has been used by myself in certain cases especially where the diagnosis of an hypophyseal tumor is in doubt or the tumor very small where there must be a question as to whether one is dealing with an extrahypophyseal tumor or one that has grown up into the cranial cavity but in all cyst and all tumor causing enlargement of the sella the intranasal operation remains the procedure of choice by the author. The intranasal technique is as follows:

The nose is packed with strips of adrenalin gauze to lessen the bleeding. The patient is placed in a recumbent position so that the blood will not accumulate in the sphenoid sinus and over the field of operation. A tight posterior nasal gauze plug is inserted. This is not so much necessary to prevent blood entering the pharynx since if the operation is done properly there should be no tear in the mucous membrane but it does prevent air escaping through the nares during the operation. An incision of the skin down to the bone is now made in the crease close under the nares and the alae of the nose. The nasal

spine is cut and with the greatest of care the mucous membrane is raised from the floor of the nose and off of the septum back to the sphenoid bone and off from the front of this bone. The septum and the anterior wall of the sphenoid sinus are now removed followed by removal of the posterior wall i.e. the anterior wall of the sella turcica. This is best entered by a chisel and the bone removed by a punch forceps. The dural covering now being cut the soft tumor mass appears and may be curetted away. If a cyst is found its walls should be gently curetted and in my experience should be lightly packed with gauze saturated with a weak iodine solution to favor obliteration of the sac or preserve an opening into the sphenoid. If a solid tumor is removed no drainage is necessary if the bleeding is well controlled. The mucous walls of the removed septum are allowed to fall together a subdermal stitch closes the skin wound the nares are pricked lightly with his mouth subnitrated saturated gauze the posterior nasal plug removed and the patient returned to bed.

The anæsthetic is best given through intra tracheal insufflation or a pharyngeal tube although the author has in a few cases used rectal anæsthesia. The operator should be familiar with the anatomy of the interior of the nose and especially the sphenoid sinus and the relations of the sella turcica. He should provide himself with proper instruments and an excellent headlight. No matter what method of approach is used the operation is difficult and should be undertaken only after thorough preparation.

CASE 1 Typical Froelich type of hypophyseal disease suffering with marked signs of intracranial pressure. Operated upon six years ago infranasal route cyst evacuated recovery result of feeding pituitary gland over three years. *Discussion abbreviated from previous report* Stanley W. aged 18 white male native of United States. Admitted to Wesley Hospital February 6 1911 under diagnosis of hypophyseal disease made by Dr. Hugh T. Patrick.

Present illness The present trouble date from his fourteenth year. Though mentally bright and well developed he lacked physical development and vigor. His appearance was anæmic. His voice did not show the normal change which takes place about puberty and he remained sexually unde-

veloped. He began to have frequent attacks of sick headaches with which he had considerable gastric distress nausea and vomiting. During his fifteenth year he began to notice that his eye sight was failing and obtained considerable relief by using glasses but on account of more or less photophobia he wore smoked glasses part of the time. Under these conditions he continued his work as clerk in comparative comfort until about a month ago when his eyes suddenly failed him. He had aching pains in the eyeballs. At times his pupil would dilate markedly especially when the pain was bad. Photophobia and impaired vision became more marked. With this he developed an acute and spasmodic frontal and temporal headache. The pains were sharp and shooting and frequently radiated into the occipital region. On February 18 he had his first attack of vomiting which he attributes to the onset of a paroxysm of headache. These attacks became more severe so that for three days he has had continued headache and vomiting and has eaten nothing.

Examination General appearance that of a boy of 12 years slightly anæmic full growth of nails and hair on head general conformation adiposity above the average but not excessive due possibly to prolonged vomiting acetone marked in urine no excessive development of breasts no growth of hair on body or pubic region except fine hairs invisible to ordinary inspection back normal ears normal teeth normal nose normal right eye slightly divergent pupils slightly large and they have been so while patient has been in hospital subsequent to the operation. Patient states that they are always so during his attacks of pain but that they may be smaller between attacks. The testicles are both present but they and the penis are very small.

The examination of the thyroid lung heart and abdomen was negative. Height 145 cm. (Patient says his height was 4 feet 9 inches (i.e. 145 cm.) a year ago.)

Operation February 1 1911. The technique of operation in this case was reported in detail in the earlier contribution so will not be given here.

The cyst was curetted thoroughly and the contents given to Dr. Zeit for examination. This consisted of a granular detritus. An attempt was made to secure the cyst wall but it was unavailing.

His polyuria returned after about ten days. Then it was noted that he had a marked acetoneuria which yielded largely under levulose and carbohydrate treatment. The polyuria also subsided rapidly.

This patient was fed three years on pituitary extract at first the anterior lobe and at the end of six months the whole gland was used. There was a distinct but not normal growth of hair but no evidence of growth in height or size careful measurements being taken.

There was no appearance of genital function no apparent growth in the size of the testicles The voice did not become more masculine The excessive adiposity was lost and the urinary function was restored to normal except that the sugar tolerance remained above normal at the end of two years Mentally he is bright and conducts his business in a capable manner There has been no change in the field of vision since the last report In other words the atrophy then present has persisted but no new signs have developed

CASE Froelich type of hypophyseal disease. Blind in one eye Operated upon with fatal result Meningeal C. N. Wesley Hospital No 42499 Referred by Dr Elliott Single female 21 years of age Entered hospital June 2 1913 discharged July 1 1913 Present illness Began eight years ago Patient states that about 8 months ago her right eye began to grow dim and finally her eyesight disappeared entirely Patient says she has never menstruated Has had headache since 13 to 15 years of age continuing for several hours until doctor gave her thyroid extract or 6 weeks ago when headaches ceased The headaches did not remain in one place and were present at varying intervals from hours to 3 or 4 days Patient came from Russia Had been in United States 9 months Previous health Has always had good health until beginning of present trouble Family history Father and mother living and well Two brothers and five sisters living and well and all are of normal development Occupation Clerk in father's merchandise store in Russia In United States did needle work until 2 months ago when she discontinued work on account of beginning blindness Patient shows good intelligence Has had high school education and private lessons When a child did not care for play with children Physical examination Dr Elliott June 13 1913 General appearance Patient appears as a little old woman Dwarf size Intelligent expression Symmetrical without abnormal developments except arms slightly longer in comparison with rest of body Patient appears intelligent and bright Height 51 inches Anterior superior spine to heel 29 inches Acromion to tip of finger 23 inches Circumference (1) of chest nipple line 26 inches (2) of abdomen umbilicus 24 3/4 inches (3) of arm right 7 1/2 inches left 7 inches (4) of forearm right 6 3/8 inches left 6 3/8 inches (5) at intercostal 26 (6) at trochanters 28 1/4 (7) thigh right 14 3/4 inches—left 14 3/8 inches (8) leg right 9 3/8 inches—left 9 1/2 inches Ears well formed Teeth well developed No evidence of cleft palate Eyes Pupils large Left reacts readily to light and accommodation Right does

not react to light Best Diffuse male type Hair Fine Absence of axillary and but slight pubic Trace on back of forearm Little on anterior surface of leg Other than this no signs of degeneration on Skin Harsh dry scaly especially over lower extremities Hardness of subcutaneous tissue of lower extremities abdomen and back but not of arms Adenopathy Absent No palpable thyroid Gland Well formed Expansion equal and symmetrical Breathing costal type Lungs resonant throughout Diaphragm anterior and posterior normal height Breath sounds and vocal fremitus normal anterior and posterior Heart Nipple line fifth interspace third rib right sternum Tones no murmurs No evidence of congenital heart lesions Abdomen Liver palpable at costal edge Caput coli easily palpable Kidney not palpable Descending colon easily palpable Spleen not palpable nor is there dullness Skelton All bones are small but in good proportion Head well formed and symmetrical Pharynx Examination June 12 1913 by Dr Wilso Normal No adenoids Nothing in nares Tonsils normal

Patient was given on succeeding days increasing doses of glucose up to 250 grams in lemonade At this time patient vomited so persistently that increase as discontinued At no time did sugar appear in the urine Urinary is throughout was negative No casts albumin or other evidences of disease The largest amount of urine recorded in any one day was 1400 cubic centimeters Blood analysis showed the following 4160000 red blood cells 6000 white blood cells Differential count lymphocytes 36 large mononuclears 2 polymorphonuclears 59 eosinophiles 3 haemo lobin 65

Operation Posterior nares plugged Nose packed with gauze saturated with adrenalin Technique Decompression of pituitary body Incision around junction of alae of nose with face Cartilaginous septum freed from vomer and ethmoid Bony septum chiseled away anterior wall of sphenoidal cells cut through with chisel Floor of sella turcica chiseled away and dura incised Cyst opened Considerable fluid mixed with blood escaped Nose replaced and stitched with subcuticular suture of silkworm Operative field packed with strips of bismuth gauze Posterior nasal packing left in place Postoperative results June 8 24 hours after operation patient showed internal strabismus due to paralysis of external rectus muscle seemingly the left There was also a paresis of the left side which cleared up somewhat June 8 p.m. Patient had temperature of 104 F Retraction and rigidity of neck Positive Kernig's sign June 30 spinal puncture and with drawal of about one test tube full of cloudy fluid Streptococcus recovered from fluid Died following day

CASE 3 Typical Froelich type of disease Operated upon on three successive occasions for relief of pressure with ultimate recovery R B Wesley



Fig. 1 Position of patient for hypophysis operation

Hospital No 4576 Single male white 18 years of age Admitted January 6 1914 Discharged February 19 1914

Present complaint Began 6 weeks ago and first appeared as failing eyesight in left eye Shortly after that headaches through both eyes and both temporal regions The headache is of a throbbing character When he goes out and walks his headache is better The headache sometimes passes away for an hour at a time then again persists through the entire day Has headache every day Does not as a rule have to get up to pass water and only passes his urine 3 or 4 times a day Patient thinks that he is not as fleshy as he was a year ago Never had any sexual power Does not complain

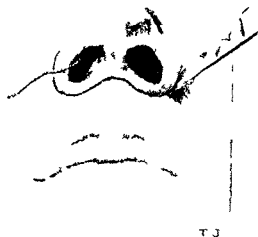


Fig. 2 Line of incision A string attached to posterior nasal plug

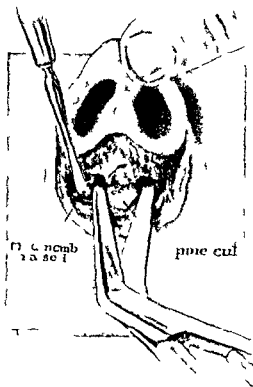


Fig. 3 The mucous membrane is raised from the floor of the nose and the palate The bony palate is being cut

of drowsiness or any mental lethargy Smell and taste normal For last two months has been unable to read word and letters blur and cannot be seen *Past illnesses* Measles and mumps only Vaccinated at 10 years of age Never sick until last year *Family history* Father aged 59 has asthma had headaches a good deal during last year

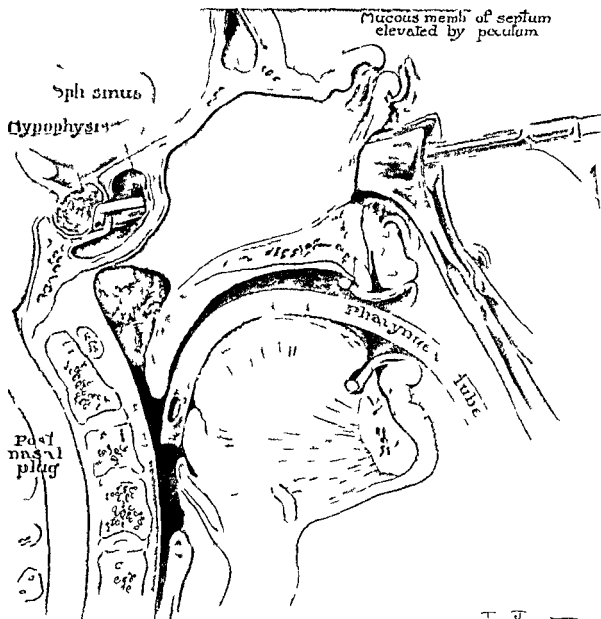
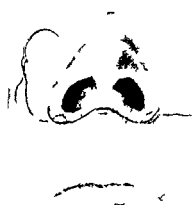
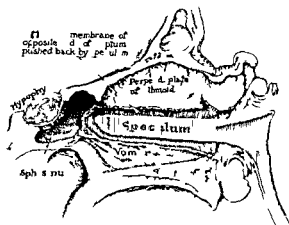


Fig 5 Hypophy ectomy

the operation. *Findings* Extensive adhesions of mucous membranes of sides of nose to one another. Deficiency in septum from previous operation. Cyst in sella turcica containing several drams of chocolate colored fluid. *Technique* Nose reflected upward. Septum showed deficiency edges of which were bitten off with forceps. Opening in sphenoid sinus exposed and enlarged. Opening into sella turcica punctured. Several drams of fluid escaped. Walls of cyst curetted and packed with bismuth gauze. Incision in scar of former operation. Cyst cavity packed with bismuth gauze. Nose replaced and both chambers packed with gauze. Preliminary plug in posterior nares which was removed after operation. Closure with subcuticular silkworm sutures. For skin preparation tincture of iodine parts glycerine pint.

The anesthetic was given by the intratracheal method. Patient again made an uneventful recovery and left the hospital at the end of one week after the operation. He returned again September 18, 1914, in the same condition as when he first entered the hospital except condition more severe than when first admitted. He was again operated upon by the same method as previously except that the cyst was packed for 3 days with a strip of gauze saturated with iodine. Gauze was then removed following which time he developed a basal meningitis which threatened his life for a number of days but finally ended in recovery.

After this he left the hospital and at last record 3 years after the operation he has had no recurrence of the symptoms and has re-



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It is not clear that the subject

trained well in every respect. There has not, however, been any recurrence of the physiological functions in regard to exaltation. There has not been a growth of hair. His excessive adiposity has disappeared. He is mentally bright and capable of carrying on his occupation of farming.

PATHOLOGICAL REPORT AND DISCUSSION BY
DR. HARRY JACKSON

A sect n of th cv t remove l char ne l
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Cystic tumors having the characteristics of the buccal mucoi occur in the jaw and have been described as polycystic adenomatoma. They originate from inclusion of mouth epithelium within the developing bone of the jaw. That similar tumors originating from the buccal mucoi could be found in the hypophyseal region was not known till a few years ago. Erdheim¹ has

known that portions of the buccal mucosa may persist as remnant of Rathke pouch near the infundibulum of the hypophysis and later proliferate to form cystic or adamantin tumors. I have collected 37 cases from the literature of such tumors reported under various title such as epithelial tumor of the infundibulum, papilloma of choroid plexus, cystic endothelioma of the pituitary epithelioma of the multiphase type, adenoma, adenocarcinoma, dermoid and cholesteatoma. Since my report Wirthlin has reported an adamantin carcinoma which has a similar origin. The tumor all originate from inclusion of epithelium which reach the hypophysis from the cranio-pharyngeal duct. The duct during embryonic life form a passage from the pharynx to the brain cavity traversing the sphenoid bone. Its upper extremity pinches off to form the anterior lobe of the hypophysis while its lower extremity forms the pharyngeal hypophysis. The duct usually atrophies but in some instance may persist.

The gross characteristics of craniopharyngeal duct tumor render them easy of diagnosis. They originate anterior to the hypophysis in the median line and in their growth push the hypophysis backward and downward sometimes leading to complete pressure atrophy of that organ. The base of the

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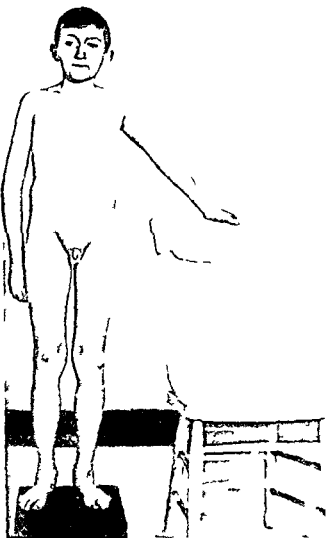


Fig. 118 Stanley W. after operation

brain is pushed upward and laterally. As the tumor is bounded by the circle of Willis and early produces pressure upon the optic tracts disturbances of vision leading to blindness are quite common. The tumors attain a diameter of 10 to 15 centimeters and under



Fig. 119 Photograph of K. B.

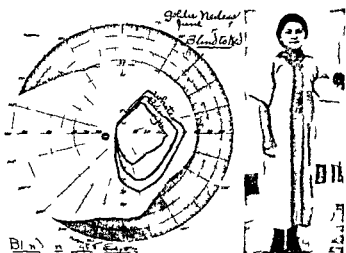


Fig. 9 Photograph and eye grounds of G. N.

go cystic changes early because of the tendency of buccal epithelium to become hydropic. The cysts contain mucoid or hemorrhagic fluid and their inner surfaces are often covered with papillary outgrowths.

The microscopic picture is that of stratified epithelium of the buccal type lying in an embryonic connective tissue stroma. Sometimes the epithelium undergoes a malignant change to carcinoma and regional metastases may be formed. This occurred in four of Erdheim's series.

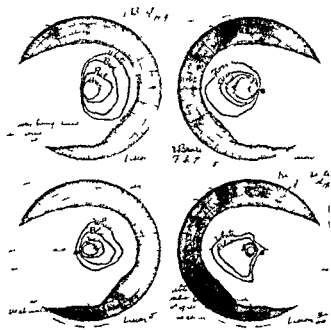


Fig. 11 Eye grounds K. B. Lower group before operation and upper group after operation

Because of the prostatic atrophy of the hypophy is hypopituitarism results and the patient exhibits the adiposity and genital atrophy of the Froelich syndrome. It is

to be hoped that more cases of this type will be recognized in the future as they represent the most common tumor associated with the Froelich syndrome and optic atrophy.

TRUE PROSTATIC CALCULI

B. HERMAN I. KITSCHIN, M.D., F.A.C.S. (Chicago) and J. C. CHILDS, M.D., M.H.P. (Chicago)

STONES occurring in the urinary bladder have been known to the older surgeons for every century. While bladder stones are of frequent occurrence and prostatic calculi occur relatively infrequently nevertheless it is but natural to expect that the older surgeons were also more or less familiar with the occurrence of stones in the prostate. One of the recent articles gave a brief historical review in which he stated:

The first reports of prostatic stones are found at the end of the sixteenth century. In 1571 that time there were no definite reports. Marcellus Donatus in 1566 reported a case in which a stone was found in the prostate of a man who could discharge only a little watery sperm. He also mentioned several stones found in the prostate of a physician, John Douglas, in the beginning of the eighteenth century. He described briefly the size of a pea found in the prostate of an old man. Thirty years later (1733) I have a more accurate description of the affection. From this time on there were more accurate reports of the condition. By Louis (1747) and in 1762 Morgagni made his report on the corpora calcarea which he has till this day.

Other reports were by Home in 1811 and 1813, by Amussat in 1832 and by Marcet in 1883. But in spite of this Civiale stated in 1838: "Their origin is very dark; they have not been studied accurately enough so that it can be said under what pathological conditions they are formed nor what organic changes lead to their formation."

Prostatic calculi are generally classified as true and false. By true prostatic calculi are meant calculi that are situated within the substance of the prostate gland. They are further classified as primary or endogenous and secondary or exogenous.

By false prostatic calculi are meant urinary calculi that have become lodged in the prostatic urethra. This group of calculi obviously does not belong to true prostatic stones and should not be included with them. In many of the cases reported in the literature however no such differentiation is made and cases are erroneously recorded as prostatic calculi when they should be reported as cases of calculi in the prostatic urethra.

This paper will be limited to a discussion of true prostatic calculi only.

Primary prostatic calculi have their origin within the prostatic tissue. They consist in the main of phosphate, carbonate or oxalate of lime or magnesia or triple phosphate.

Fraser (quoted by Childs) gives the following composition of primary stones:

	Per cent
Calcium phosphate	84.5
Calcium carbonate	5
Organic matter	0

Dupuytren (quoted by Childs) gives the

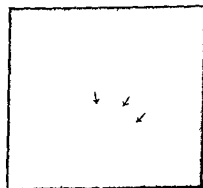


Fig. 1. C. Multiple prostatic calculi. (Childs, A. I. 3, 44)

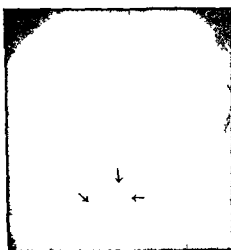


FIG 2

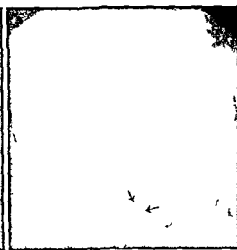


FIG 3

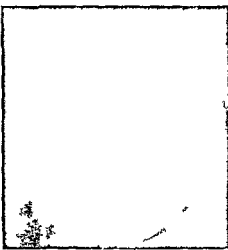


FIG 4

Fig 2 Case Recurrent prostatic calculi
Fig 3 Case 3 Small shadows in region of prostate
resembling calculi obtained by prostatic massage

Fig 4 Case 4 Calculi in prostate Roentgenogram
taken after 157 tones had been removed from the
bladder

composition of four stones obtained from a patient aged 41 as follows

	P	C	t
Calcium phosphate		60	
Ammoniummagnesium phosphate		0	
Calcium carbonate		20	

Secondary prostatic calculi can be differentiated from the primary by their chemical composition the nucleus in these cases being composed of urates and earthy phosphates. The difference between the primary and secondary calculi must rest upon the chemical examination of the nucleus for in this way only is one able definitely to determine whether one is dealing with a primary or a secondary stone.

Secondary stones may have an outer coating of the same composition as the true calculi. Hence the importance of the determination of this point namely to have the center of the stone subjected to careful chemical examination. The opposite may also be true. A primary prostatic stone may be covered with urates in cases in which a communication exists between the cavity harboring the calculi and the urethra.

A review of the literature reveals several rather interesting facts the more important of which appear to be the following

1 That prostatic calculi occur more frequently than is generally believed

That great carelessness in reporting the cases

is obvious. Many of the case reports do not show an attempt to separate the cases of true from those of false prostatic stones.

3 That the symptom complex presented by these cases is not always typical.

4 That in some of the more recent case reports the routine employment of the roentgen ray has not been resorted to so that the use of this diagnostic aid is not as universal in the diagnosis of this condition as it is in the diagnosis of calculi occurring in other parts of the genito-urinary tract. The routine employment of the roentgen ray for the demonstration of these stones in all obscure cases should be strongly urged especially in the cases of so called chronic prostatitis which do not respond to the usual forms of treatment.

A careful review of the literature shows that more cases have been reported than is generally known. Most writers who have published cases call attention to the fact that the number of cases that have been reported is very small. Thus Glaeser including his own two cases was able to bring the total number of cases reported up to 34. In this review records of 165 cases have been found. With the 8 cases reported in this paper the number of recorded cases is brought up to 173. Doubtless many cases have been overlooked. Furthermore because of the indefinite and incomplete reports of others there may be a few that have not been included. Cases about which there was the least suspicion as to their true nature were not included.

During the past years I have had the opportunity of seeing 8 cases and believing

Microscopic examination shows the presence of pus cells and bacteria. A culture reveals the presence of bacillus coli.

CASE 3. Mr L aged 30. Prostatic calculi associated with tuberculosis of the epididymis.

Present complaint. Swelling of the right testicle and a discharging sinus in the right side of the scrotum. The patient states that the trouble began two years ago last March. There was no pain or tenderness associated with the swelling and there was no history of trauma. Four months later an incision was made into the scrotum for drainage. The patient has seen pus but no blood in the urine. He has never passed a stone. He had gonorrhoea six years ago.

Examination. The right testicle is enlarged and nodular. The epididymis is enlarged both poles and body. There is a small opening through the skin into the globus minor.

Rectal examination. The prostate is not hard nor enlarged and not tender.

Roentgen ray examination. The roentgenogram (Fig 3) shows the presence of 3 small shadows behind the symphysis pubis compatible in size and shape with calculi in the prostate and with the stone passed after the rectal examination (see below).

Urinalysis. Cloudy straw colored 1014. No albumin sugar or casts. Microscopic examination showed pus cells.

Passage of stone. After the rectal examination the patient was asked to void and in the voided urine a small calculus was found.

Chemical examination of calculus. One hard light yellow calculus of the size of the head of a black pin. This calculus consists largely of calcium carbonate with a small amount of calcium oxalate and only a trace of organic detritus. (R W Webster).

CASE 4. Mr A K aged 21. Prostatic calculi associated with vesical calculi.

Present complaint. Six months ago the patient began to have painful urination which is still present. There also had been considerable difficulty in starting the stream and the patient has had more or less dribbling at the end of urination. He states that occasionally there is a sudden stoppage of the stream. He further states that the urine has always been clear and that he has never passed blood. He denies all specific infection.

Cystoscopic examination. Many small calculi were seen in the base of the bladder. These were removed with an evacuator and 157 stones were obtained. The patient was cystoscoped again in five days and no stones were found in the bladder.

Roentgen ray examination. The roentgenogram (Fig 4) shows the presence of shadows compatible in size and shape with calculi in the prostate. This roentgenogram was obtained after the bladder calculi were removed with the evacuator and after the second cystoscopic examination demonstrated that the bladder was free from calculi so that the possibility that these shadows are due to calculi in the bladder is excluded.

Chemical examination of the bladder stones. One hundred fifty seven hard light yellow calculi varying in size from 1 pin point to a millet seed. These calculi consist largely of calcium oxalate with a small amount of magnesium and calcium phosphate and a very small amount of organic detritus. (R W Webster).

Urinalysis. Clear acid 1022. albumin a trace sediment a few red blood cells few leucocytes.

CASE 5. H P aged 46. Prostatic calculi associated with nephritis.

Present complaint. The patient denies syphilis and gonorrhoea. Five months ago he noticed a parietal headache appearing at night. Two weeks ago he had severe attacks of nausea and vomiting which had no relation to the taking of food. Five days before admission to the hospital he had severe colicky pains in the abdomen which lasted for four hours. One week ago the patient noticed that the urine was bloody. There were no other urinary symptoms.

Examination. The cystoscopic and rectal examinations were negative. Ureteral catheterization showed the following. The urine from the left ureter was clear that from the right bloody.

Urinalysis. Examination of the urine from the left side shows the presence of albumin and casts that of the right side shows blood.

Roentgen ray examination. The roentgenogram was negative for stones in the kidney and bladder. Behind the symphysis pubis are seen many small shadows compatible with calculi in the prostate. (Fig 5).

CASE 6. F A K aged 57. Prostatic calculi and cerebrospinal syphilis.

Present complaint. Four weeks ago the patient began to complain of pain in the hypogastrium following urination. The pain came on abruptly and was sharp and cutting. It was especially severe when defecation took place with urination. It caused him to double up and at times he also had pain in the epigastrium. Walking sometimes aggravated or brought on the pain. Four or five days after the onset of this trouble the patient developed incontinence so that he was obliged to wear a rubber urinal. There has been some difficulty in starting the stream which is slow lacks force and dribbles.

Examination. The patient is a well developed and well nourished man. The pupils are equal and slightly irregular. They react slightly to light and test well for accommodation. Finger to finger causes slight incoordination. The knee jerks are equal and normal. The Babinski is constant on the left side. Pain sense is diminished in the arm chest abdomen and legs.

Urinalysis. There is no albumin sugar or blood in the urine. It contains a few granular casts and leucocytes. The culture is sterile.

The blood Wassermann is positive. The spinal fluid Wassermann Nonne and Lange were also positive. cells 88.

The rectal examination was negative.

Röntgen ray examination: The roentgenogram shows the presence of many small shadows behind the symphysis pubis compatible with shadows produced by prostatic calculi.

CASE 7. N. N. aged 44. Prostatic calculi associated with chronic prostatitis.

Past history: The patient had his first attack of gonorrhoeal urethritis when about 21. His next attack was at 3 and the third at 11. In the spring of 1902 he had an interstitial urethritis. The patient was subsequently married and has four healthy children.

Present complaint: In February, 1916 he began to suffer from pain in the left kidney region and turbid urine for his health as usual.

Cystoscopic examination and catheterization: Ureteral catheterization was performed with instruction. Cultures made from the catheterized kidney specimen showed the presence of *flavus mucosus capsulatus*.

Rectal examination: Shows the prostate to be firm in consistency. The prostatic trigones showed the presence of pus.

The roentgenogram: Shows the presence of prostatic calculi (Fig. 7).

CASE 8. M. W. aged 60. Prostatic calculi associated with benign hypertrophy and stone in the ureter.

Present history: The patient states that his present illness began about three years ago with bladder distress. Frequency of urination was the first symptom. The patient noticed at first he was obliged to rise once or twice at night. At the present time he is obliged to void from three to five times every night. Beginning on urination began at about the same time that he noticed the frequency. The patient has had two attacks of complete retention of urine, one attack being relieved by a single catheterization. The second attack lasted for about a week during which time the patient had to be catheterized three times a day. During the attacks of complete retention the patient had chills and fever and sweats. There is also a rather definite history of night side anal pain.

Röntgen ray examination: Shows the presence of a stone in the ureter and the presence of calculi in the prostate (Fig. 6).

Rectal examination: Shows a uniformly enlarged prostate, both lobes are easily palpable. The prostate is smooth and soft and not tender. No sensation of crepitation was elicited.

OCCURRENCE

It is usually stated in articles dealing with this subject as well as in textbooks that prostatic calculi are very rare in fact that they are so rare as not to have any clinical importance. Thus Legueu in 1895 wrote that there were no calculi in the prostate

only in the prostatic urethra and Marion in 1906 said that their existence was uncertain and at any rate they had no clinical importance (Tanton). It would seem that this traditional statement has been handed down from one writer to another without any serious attempts having been made to disprove it. That these cases are of clinical importance is evidenced by the clinical reports of cases. The fact that a review of the literature has brought to light 165 cases exclusive of the cases reported in this paper is positive proof that they are not infrequent. No doubt there are many patients suffering from prostatic calculi who do not obtain relief owing to the fact that the condition is overlooked or perhaps it might be better to say that the possibility of the presence of such stones is not considered so that many cases are treated by massage irrigations etc. without benefit.

THEORY OF FORMATION

Up to the present time the origin of prostatic calculi has not been determined and the various views expressed are purely theoretical. Because of the frequency of chronic urethritis many believe that this condition plays an important rôle. Yet there are many cases in which a history of previous urethral infection cannot be obtained. A history of gonorrhoeal infection was present in 3 of my cases, it was denied in 2 cases and in 3 cases no mention of gonorrhoea was found in the history.

Rochet believes that prostatic calculi result from chronic urethritis. Pons is willing to accept the explanation of Pasteau until a better one is offered, namely that they are due to a mild chronic infection of the acini and excretory ducts of the gland. The fact that they are almost always observed in the adult after posterior urethritis gives credence to this view. It is believed that this local chronic infection gradually causes certain salts of the urine to be precipitated and deposited around the normal concretions of the gland through the dilated prostatic tubules.

Tarnaud is of the opinion that these calculi are formed by the deposits of salts chiefly phosphates and carbonates of lime around a nucleus composed of normal prostatic con-

cretions Their formation is due to mild chronic infections

Adams states that the prostatic concretions may become the nucleus of a calculus

According to Socin and Burckhardt prostatic calculi may be formed by encrustation of the prostatic concretions and they state furthermore that it has been shown at autopsy that ordinary suppurative inflammations of the prostate may exceptionally end in the thickening and calcification of small circumscribed foci of pus and thus form stones in the gland

Rochet and Moutot believe that it is generally admitted that large prostatic calculi are the result of encrustation with phosphates and carbonates of lime of the physiologic concretions of the prostate

Tanton concludes that true prostatic calculi are the result of calcareous encrustation of the physiologic albuminoid concretions of the prostate If the calculus is sectioned and an organic nucleus found it proves its endogenous origin

It is the belief of Albarran that the concretions are physiological and that prostatic calculi are formed from them by conglomeration of a great number or by the deposition of calcium phosphates

According to Spencer the origin of prostatic calculi is found in the protoplasm of degenerated gland epithelium around which colloid material is deposited This eventually undergoes amyloid degeneration Subsequently mineral salts are deposited around it calcium phosphates calcium carbonates animal matter and pigment

Crosse in his article states that prostatic calculi are formed in the ducts of the prostate gland deposited from its natural or disordered secretion and composed uniformly of phosphate of lime They seem to be sufficiently often combined with stone in the bladder to lead us to suspect that the one disease helps to cause the other and he believes that urinary calculi stricture of the urethra or any disease causing inflammation of the prostatic part of the urethra and interrupting the free exit of prostatic excretion disposes to the formation of prostatic calculi

Glaeser is of the opinion that the primary

calculi are formed in the parenchyma of the gland itself the nucleus being formed of corpora amylacea or necrotic bits of tissue They increase in size by encrustation with phosphates carbonates or oxalates of lime or magnesia or triple phosphates

SYMPTOMATOLOGY

Clinically cases of prostatic calculi may be divided into three groups

1 Those cases in which the calculi are found in a more or less accidental manner and in which the calculi are not producing any symptoms that is the patient comes to us seeking relief for another condition as did the patient in Case 5 who was suffering from hæmaturia due to chronic nephritis As a part of the routine examination the stones were found In another case (Case 6) the patient came in because of bladder symptoms due to cerebrospinal syphilis and the shadows were found in the roentgen ray examination

Those cases in which the calculi are associated with benign hypertrophy of the prostate and in which the clinical picture is that of benign hypertrophy The patient seeks relief not from his prostatic calculi but from an enlarged prostate as was the case in Case 8 As a result, the presence of the calculi is generally not recognized before operation They are usually found at the time of the prostatectomy In this group of cases the calculus may be found located within the gland substance proper or it may be found situated between the gland and its capsule Cases belonging to this group have been reported by Fowler Keen MacGowan, Krotzyner Lund Naumann Tidnat Moucharinsky Chopart and others In Fowler's case the calculi were found to be situated between the prostatic capsule and the gland tissue

3 Those cases in which the symptoms are due to the presence of the calculi and the patient comes to us directly for the relief of this condition It is this group that is usually meant when the subject of prostatic calculi is mentioned

The symptoms are not always characteristic so that it is not possible to make a diagnosis from the clinical history alone

This and the fact that it is rarely thought of as a possibility may explain why the diagnosis of calculi is not made oftener than it is.

The symptoms of prostatic calculi may be conveniently divided into four more or less arbitrary groups: prostatic, urinary, sexual and rectal.

1. Prostatic symptoms may be considered as being directly due to the presence of the calculi in the prostate. The most important are (a) pain, (b) passage of the calculi, and (c) abscess formation with or without resulting fistula.

a. Nearly all patients complain of pain at some time or other during the course of their illness. The pain is often associated with urinary distress, although at times it is absent. The pain may be localized to the prostate and be referred to the penis in the prostate. Very often however the pain may be referred to the perineum and perineal scrotum, urethra, suprapubic area and occasionally it may be referred down the thigh. Sometimes the perineal pain is described as being very severe while at other times it may be described as a feeling of weight or heaviness in the perineum. The pain in the perineum may be aggravated by sitting, so that the patient may avoid sitting directly on hard surface. In 1 case of my series the pain was referred upward toward the cecum.

b. Passage of prostatic calculi *per urethram* does not occur very frequently and hence must be considered one of the unusual symptoms. It is easy to see how this symptom could be mistaken for the passage of urinary calculi. Cases in which calculi were passed have been reported by (Olding, Bird, Johua, Lund, Lydton, Lister, Hedenburg, Rochet (3 cases), Sante-son, Stoecker and Van Imschoot. Stoecker's patient passed about 100 calculi and Santesson's patient discharged 22. To these cases must be added my first case, this patient having passed stones over a period of many years. In several instances the calculi have been removed by the endoscope. In cases in which the calculi were large their presence interfered with urination but as a rule the calculi are small and not large enough to produce obstruction.

c. While abscess formation with or without resulting fistula is exceedingly rare cases have been reported in which fistulae were present that were undoubtedly the result of prostatic calculi. In some of the cases the calculi were removed through the fistulous openings (Dupuytren, Johua, Crosse, Barker and Devin).

As would naturally be expected the urinary symptoms are the predominating ones in all sorts of urinary symptoms are mentioned in the various case reports. In 8 cases frequency of urination either alone or associated with other symptoms was present. In 16 cases painful urination was recorded. Difficult urination was present in 14 cases and dribbling in 5. Burning urination, difficulty in starting the stream, incontinence, dysuria, tenesmus vesical, irritability, hematuria, residual and retention have all been mentioned. The retention in some cases was complete in others incomplete. In 1 case there was either complete retention or the patient was obliged to use the catheter part of the time.

The sexual symptoms generally do not occupy a prominent position as the urinary symptom. Yet in several instances they were the chief complaint. Diminution in the sexual desire, weak erection or complete failure of erection, ispermia, haematospemia and discharge of a watery spermatic fluid are mentioned in the literature.

4. The rectal symptoms are rectal tenesmus, pain in the rectum and anus and painful defecation.

ASSOCIATED PATHOLOGICAL CONDITIONS

In 17 cases there is recorded the presence of urethral stricture. In one case (Hey) the prostate was described as being gangrenous. In 15 cases the prostate was described as being enlarged (benign hypertrophy) and in one case (Lund) the question of malignancy of the prostate is mentioned.

Of interest in this connection is the occurrence of stone in the urinary organs. Calculi are recorded in the bladder in 10 cases. Case 3 of my series added to this number brings the total up to 11. In Louquet's case calculi were also found in the kidney.

In Case 8 there was an associated stone in the ureter and some enlargement of the prostate

RECURRENCE

It is a well established fact that gall stones bladder stones and kidney stones do recur after their surgical removal and it is but natural to expect that prostatic calculi may also recur. Although this is the natural inference yet in a review of the literature I have been able to find but two cases on record those reported by Hock and Belfrage. These are the only cases in which a recurrence is recorded as far as I know. Case 2 of my series is therefore the third case of true recurrence to be reported.

If we stop to consider the pathology for a few moments one can easily see how a recurrence may take place especially in cases in which the cavity harboring the stone is very large and in the presence of much infection. In Hock's case the operation for recurrent stone was performed two years after the first operation. In Belfrage's case the diagnosis of recurrence was made ten years after the operation. In my case there was also an interval of ten years.

DIAGNOSIS

The diagnosis of prostatic calculi can be definitely established in every case by the aid of the roentgen ray. It is surprising in view of the fact that the roentgen ray is perhaps the one agent that gives us the most information in the diagnosis of this condition that its routine employment is so often neglected. Its routine use after the operative removal of stones should always be carried out so that one may be sure that all of the calculi have been removed. That this is often neglected is very plainly demonstrated by a review of the recent case reports in the literature a large number of which do not mention the roentgen ray findings. This certainly is unfortunate as doubtless many of the sufferers seek relief without finding it and are often subjected to many needless examinations and to prolonged courses of treatment without obtaining relief.

Forsell in 1909 was able to find only 4

cases in the literature in which the roentgenographic findings were given those of Golding Bird Lydston Albers Schoenberg and Haenisch. Since then cases have been reported in which the diagnosis was made by the aid of the roentgen ray by Cholzoff Cochez Briclner Mouchrinsky Naumann Ravasini R Thompson Voelcker and in the cases reported in this paper.

Forsell has described two types of shadows. One in which the calculi are very small and round varying in size from a pin head to a hemp seed and are arranged symmetrically in small groups near the midline. That this arrangement may change is demonstrated in Case 1 in which the roentgenogram taken two and a half years ago shows this typical arrangement. The recent roentgenogram (Fig 1) shows the presence of five large stones. The second type shows a conglomeration of small roundish shadows packed close together and lying symmetrically on both sides of the midline.

An examination of the roentgenograms in this series of cases shows that the grouping of the shadows is by no means constant. The large stones in Figure 1 are grouped on both sides of the midline and in Figure 2 all of the calculi are apparently located in one of the lateral lobes.

The smaller calculi may be located in the midline to one side of it or they may be located on both sides of the midline. Figures 3 4 and 5.

Next in importance to the roentgen ray findings are the results of the rectal examination. There are four signs that one elicits upon rectal examination that aid in making the diagnosis. These are (a) crepitation (b) palpation of the stone (c) expressing the calculus from the prostate and (d) changes in the prostate.

While one of these symptoms can be elicited in nearly all cases nevertheless there is a certain number in which the diagnosis cannot be made from the rectal examination so that one cannot be justified in making the statement that because the rectal findings are negative prostatic calculi may be excluded. It is easy to see how one could miss calculi that are deeply situated in the prostate or

that are very small because they would be hard to examine

a Crepitation when elicited has often been mentioned as being pathognomonic of prostatic calculi. Its absence however does not exclude their presence. It is usually produced by the grating together of several large calculi in a cavity produced by their presence. It is a symptom that was much relied upon by the earlier clinicians. It was mentioned as being present in the cases reported by Bogdanow, Brongersma, Clouff, Cooper, Golding Bird, Mouclarsky, Pavlov, Tarnaud, Rohdenburg, Sante, Son, Silvanski, Stoeckle, Svensson and Tarnaud. Crepitation was elicited in two of my cases.

b In order to demonstrate stone by digital palpation the calculus must have attained fairly large size. In cases in which the stones are fairly large the parenchyma of the gland surrounding the calculus has often become more or less atrophic so that the calculus may be easily felt. In two of my cases (Cases 1 and 2) I was able to palpate the stones through the rectum. As previously mentioned when the calculi are large it is very difficult in palpating them. Many of the reports mention this fact namely that the stones or tons were felt through the rectum (Clouff, Erlow, Levis, Naumann, Pernaud). In the case reported by Polya and Ryasnik the tons were distinctly felt while in Voelcker's case reportedly Claes the prostate was very hard and a tumor suspected. Locquin reports a case in which the prostate was distended and full of stones.

c Expressing the calculus from the prostate by prostatic massage may occur in cases in which the calculi are small and when one can demonstrate the calculi in this manner our suspicions of the presence of more calculi in the prostate should be verified by roentgenograms. Calculi have been expressed from the prostate in the cases of Balssa, Bonneau, Bonfick and Sennson and in Cases 3 of this series.

d The rectal examination in many cases demonstrates an increased consistency of the prostate which may or may not be associated with an increase in the size of the prostate. At times the prostate may be described as being as hard as stone. Increased consistency of the prostate occurring in early adult life should arouse one's suspicions for the possibility of the presence of calculi. Others in older persons increased consistency may be significant of malignancy. The prostate may be uniformly hard as in the cases reported by Bogdanow, Fowler, Lister, Lund, Masti, Maunders, McMunn, Polya, Pousson and Jaubert de Beaujeu. Some times this increased consistency may be more or less nodular so that the finger in the rectum obtains a sensation of a hard nodule being present in the prostate. Such cases have been reported by Brongersma, Lund, Psalidas, Poldenburg, Van Imschoot and others.

TREATMENT

The clinical classification of cases as given above may be used as a guide in outlining the surgical treatment.

Thus the cases of small multiple calculi that are not producing symptoms and are discovered in a more or less accidental way during the routine examination do not call for surgical treatment. Their presence should be noted and their progress controlled by repeated roentgen ray examinations.

The second group namely those cases in which the calculi are associated with benign hypertrophy of the prostate are usually candidates for prostatectomy and at the operation the calculi are removed. The condition calling for surgical intervention is the benign hypertrophy, the presence of the calculi being merely an incident.

In the third group of cases the indications are to remove the calculi because of the subjective symptoms which they produce.

The non operative measures such as removal of the calculi by massage or by the endoscope are methods that have a very limited field of usefulness and at least must be considered as temporizing measures.

The radical removal of the calculi can be best performed by perineal prostatectomy. When the calculi have been removed one should thoroughly examine the wound to see that no stones have been overlooked. It is necessary to break up any septa that may be present so that all possible sites for the reformation of stones are removed.

In cases of recurrent calculi one must consider carrying out some procedure that will prevent further stone formation and with it a return of the symptoms. With this end in view it would seem logical to perform prostatectomy.

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THE REPAIR AND RECONSTRUCTION OF THE HEPATIC AND COMMON BILE DUCTS¹

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THE consideration of the treatment of benign stricture of either or both the hepatic and common ducts due to partial or complete obliteration of their lumen is most interesting for it frequently directly concerns the ability of the surgeon to replace the damaged segment of the duct with a new channel with the hope and possibly the expectation that it shall permanently serve the purpose of conducting the bile into the intestine.

While the methods of duct reconstruction adopted after excision of a malignant growth at the papilla or more rarely in the supra duodenal part of the duct do not differ essentially from those employed for the relief of cicatricial stricture the almost inevitable recurrence of the growth and the subsequent death of the patient which take place before the end result becomes established and consequently before the permanency of the new duct can be definitely determined warrant the exclusion of the consideration of this particular group of cases at the present time.

Benign strictures ordinarily follow the healing of an ulcer the result of pressure of a stone or of subcutaneous trauma or much more commonly the result of unrecognized division or excision of a segment of the duct in the course of a cholecystectomy or difficult choledochotomy. They may also follow an infectious cholangitis terminating in necrosis of the mucous membrane of the duct in which event the larger portion of the duct may become stenosed or obliterated.

The study of case reports shows numerous instances of strictures due to damage to the junction of the cystic and hepatic or to the hepatic or common duct alone in the course of a cholecystectomy. If recognized immediately the defect can usually be satisfactorily and easily repaired otherwise stricture is almost certain to develop and the necessary operation for its relief becomes much more difficult and dangerous. For this

reason it is advisable briefly to state the conditions which predispose to this accident and to suggest measures by which it may possibly be avoided.

The following anatomical and pathological predisposing factors must be emphasized:

1. An abnormally short cystic duct and a correspondingly short pedicle.

An abnormal course of the cystic duct in that it runs parallel and sometimes closely united to the hepatic duct for a considerable distance above the junction. Rarely the cystic duct crosses the hepatic duct to open on its mesial aspect.

3. The pathological predisposing causes include a shortening of the gall bladder pedicle from the extensive contraction of long standing inflammatory adhesions or a pedicle materially shortened by an unsuspected dilatation of a considerable portion of the proximal portion of the cystic duct.

4. In a number of instances damage to the hepatic or common duct has resulted from the effort of the surgeon to secure with a hemostat a retracted bleeding cystic artery. The attempt is successful but at the expense of including a portion of the duct wall in the grasp of the forceps. A peculiar friability of the tissues forming the gall bladder pedicle which is sometimes found in cases of long standing cholelithiasis predisposes to this accident through the cutting through of the ligature. In one instance of this kind the writer secured satisfactory hæmostasis only by the application of a purse string ligature in which both the divided end of the duct and the adjacent cystic artery were included.

5. The obliteration of all anatomical landmarks including the foramen of Winslow through extensive adhesions naturally increases the likelihood of injury to the ducts.

6. Difficulty of exposure because of a thick abdominal wall or overhanging liver.

To obviate as far as possible the risk of damage to the ducts in operations for long

standing cholelithiasis the operative field should be exposed through an adequate incision and the normal relation of the duodenum, colon, omentum and stomach restored to their normal position by careful separation of all adhesions. It is also essential that the gastrohepatic omentum and the foramen of Winslow should be identified. In this connection the hepatic artery may be of considerable assistance. These preliminary steps once accomplished the nature and location of the lesion may usually be readily determined and the appropriate remedy applied. In the event of a cholecystotomy, an instrumental guide introduced into the duct after the removal of the calculus and passed upward into the hepatic duct will avert all risk of damage to the ducts when the pedicle of the gall bladder is ligated. In the routine cholecystectomy the identification of the junction of the hepatic and cystic ducts is essential. The cystic duct should then be divided and the plane of dissection deepened as closely as possible to the gall bladder. The cystic artery and other vessels should be secured by a number of small rather than by one large clamp. In difficult cholecystectomies the gall bladder may be opened, emptied of its contents and the dissection of this organ from contiguous structures facilitated by the introduction of a finger into the cavity. Preferably the gall bladder is removed from below upward. If removed from above downward similar precautions should be observed as the pedicle is approached. In every case traction of the pedicle must be avoided as it produces angulation of the junction of the cystic and hepatic ducts and thereby predisposes to their accidental division. After the removal of the gall bladder the divided pedicle should be carefully inspected and the small circular orifice of the cystic duct identified. If two orifices are seen the hepatocolic common duct has been completely divided. If the orifice of the divided cystic duct has a decidedly oval shape a partial circumferential excision of the hepatic or common ducts may have occurred. In either event prompt recognition of this accident leads to its immediate repair and materially de-

creases the risk of a stricture and the necessity of a secondary operation.

The writer has collected 7 instances of excision or ligation of small portions of the duct wall of which 5 reported by Kehr were treated satisfactorily by drainage with a T tube. In one of the remaining two reported by Brewer the junction of the cystic and hepatic ducts was ligated in the course of a cholecystectomy in such a way as to diminish by one third the duct lumen. The ligature was left *in situ* without untoward result. In the other one third of the duct wall was excised in the removal of an adenoma with immediate suture. In none of these cases was subsequent stricture observed.

The reports of 25 cases of end to end suture of the duct were gathered by the writer from the literature and from personal communication. In 16 of these a primary end to end suture was done and the longest interval bridged was two inches (Kehr). In this case however a stricture developed at the end of two months and a second end to end suture was done after excising 2 centimeters of cicatricial tissues. The patient was free from recurrence 5 months afterward. In the remaining 9 cases end to end suture was done after a resection of a stricture. The longest interval bridged was 3 centimeters in a case reported by Riggs after excision of a stricture at the junction of the hepatic and cystic ducts. In this case there had been no previous operation. The patient was well 4 years and a half afterward.

These 5 cases include four failures, one by Nordmann in which jaundice recurred 7 weeks after the immediate suture of the ends of a divided duct in the course of a cholecystectomy. The recurrence was relieved by a suture of the hepatic stump to the duodenum. The second failure is reported by Kehr in which recurrence followed the treatment of a defect in the hepatic duct by the Heineke-Mikulicz method. This was relieved by resection with end to end suture. The third failure was reported by Lyle, recurrence taking place two and one half years after operation. The fourth failure is reported by Wilms (see case report). In these 23 cases the tube over which the anastomosis was usually made

was either left to itself removed by forceps or brought out through a separate incision in the duct wall below the point of suture or through an opening in the wall of the duodenum. In one case (Jackson) the patient was in excellent condition at the end of 16 months save for occasional attacks of slight jaundice with epigastric pain.

While stricture almost inevitably follows division or excision of a segment of the duct a linear incision through its wall such as is made in choledochotomy usually heals without complication. One case however is reported by Kehr in which a slight linear defect was followed by stricture although an associated trauma to the main duct below is said to have been a chief contributing factor. In this case changes of a keloid character may have developed in the duct scar. Such a change perhaps may take place where following unduly prolonged drainage a scar of considerable size is left in the wall of the duct. Whether after a choledochotomy the pressure of the drainage tube predisposes to necrosis of the duct wall either at the point of its exit or in some more remote portion of the duct is doubtful provided that a soft flexible tube that does not completely fill the lumen of the duct is used. A moderately sized Nelaton catheter fulfills these conditions and in a number of instances has remained for months *in situ* without causing any damage.

The symptoms of cicatricial stricture of the hepatic or common duct are late in their development. The stricture must be far advanced before the resulting stenosis with out associated inflammation will be sufficient to cause jaundice. There is usually the history of a long standing cholelithiasis with one or more operations especially that of cholecystectomy. It is important to note however that a stricture of this kind may develop without the history of cholecystectomy or of any other operation and in case an operation has previously been done the stricture may be situated in such a remote part of the duct as to be in no way connected with the operation. In these cases of primary stricture the symptoms include a gradually developing jaundice with or without occa-

sional attacks of cholangitis during which the jaundice becomes more intense. Pain is not a marked feature and attacks suggesting a common duct stone are exceptional. In some cases physical examination discloses a moderate increase in the size of the liver. Signs of peritoneal irritation may be elicited only during the attacks of cholangitis. If the condition is not relieved the terminal symptoms are those of cholæmia with or without infection in the parenchyma of the liver itself.

The treatment of cicatricial stricture of the hepatic or common duct depends upon its location and extent and perhaps in a slight measure upon the condition of the gall bladder. One of the earliest arguments against cholecystectomy and in favor of cholecystostomy was that the sacrifice of the gall bladder made a future cholecystenterostomy impossible an operation which theoretically at least would be indicated for the relief of benign stricture in the common duct provided the hepatic and cystic ducts and the gall bladder were normal. Unfortunately however these conditions are rarely fulfilled for benign stricture of the common duct in itself a lesion of long standing cholelithiasis is usually associated with a stenosed or obliterated cystic duct and a gall bladder so atrophied and thickened that it has long since ceased to perform its normal function. Under such conditions it is quite obvious that cholecystenterostomy is impracticable while in stricture of the hepatic duct only it would of course be useless.

Exceptionally that favorable anatomical conditions exist for the successful performing of cholecystenterostomy is shown by the three cases reported respectively by Marini (biliary fistula following cholecystostomy anastomosed to the pylorus patient well two years after), Koerte (duodenocholecystostomy for apparent stricture of the papilla recovery) and Kausch (cholecystenterostomy for supposed cancer of the pancreas. Death 3 months later from infectious cholangitis. Autopsy disclosed a chronic pancreatitis causing a benign stricture). The case reported by Kausch illustrates the possibility of an ascending infectious cholangitis the danger

to which these patients are exposed and which is probably more likely to occur if there be stasis even though temporary of the flow of bile. To avert this danger Krukenberg has suggested a rotation around its vertical axis of that part of the gall bladder which is used for anastomosis. Marigliano has established an enteranastomosis and has used the excluded loop for the cholecystenterostomy while Montprohlt has after dividing the jejunum approximated its lower end to the gall bladder the continuity of the intestine being reestablished by a lateral anastomosis of the two segments of the intestine below the site of the cholecystenterostomy. The fact that none of these measures provides a satisfactory safeguard against ascending infection perhaps justifies in all cases of benign stricture the selection of some operation after which the flow of bile into the intestine is more constant than after a cholecystenterostomy reserving the latter operation for the temporary relief of obstruction in inoperable cancer of the papilla or head of the pancreas.

The extent and location of the benign stricture is of great importance in determining the selection of the appropriate remedy.

1 Stricture situated in either or both hepatic and common ducts in which the duct above and below is relatively normal and surgically accessible

2 Stricture situated in the lower end of the common duct including the orifice at the papilla

3 Strictures situated in that part of the hepatic or of the right and left hepatic ducts which are covered by liver tissue and in which therefore the dilated duct above the stricture is surgically inaccessible

The treatment of strictures belonging to the first group includes (1) The linear division of the stricture. The stricture in Case 1 herewith reported was treated by the writer in this way not with the expectation of effecting a permanent cure but with the hope that after the subsidence of the jaundice the improved condition of the patient would permit of some form of anastomosis between the stump of the hepatic duct and the intestine. After 3¹ months the complete biliary

fistula suddenly closed 24 hours before the time set for the anastomosis. Unfortunately at the end of a year the patient unexpectedly moved and every effort to trace her failed. During this interval and about six months after the closure of the fistula she had had one attack of slight jaundice of several days duration.

This method is quite analogous to that employed in an external urethrotomy and if postoperative passage of sounds were possible might be expected to yield equally satisfactory results. Division of the stricture only however cannot be expected to give permanent relief. Ultimately recurrence would appear inevitable. There is practically no evidence by which any adequate estimate of the length of the period of relief may be made. In the present instance no symptoms of recurrence had appeared one year after the operation. How much longer this favorable condition continued is uncertain. In spite of every effort to keep the patient under observation she unexpectedly left the city for Canada and no word has been received from her since. Her name is given in the hope that she either has or will seek the counsel of some surgical friend and thus permit the completion of her history.

While simple division of the stricture may give temporary relief some attempt to supplement the procedure by reestablishing the continuity of the duct is unquestionably indicated. Although as in Case 1 reported by the writer the discharge of the entire liver secretion did not affect the general condition of the patient in a detrimental way it has been clearly shown by Seidel that osteoporosis with subjective symptoms of pain and weakness develop when the biliary fistula is permanent. In one instance in which a biliary fistula had existed for three and one quarter years autopsy showed an osteoporosis of the entire skeleton and the same writer reports a second observation in which a similarly extensive osteoporosis appearing two years after the formation of a biliary fistula increased in intensity during the following two years and subsided only after the fistula had closed. In Case 1 the operation was done in 1907 and at that time duct reconstruc-

tion was in its infancy while the patient's condition did not warrant an attempt to establish an anastomosis between the stump of the duct and the intestine. The most simple measure and probably the one which gives the most satisfactory result is resection of the cicatricial tissue followed by end to end suture of the divided ends. If the accidental excision of a segment of the duct in the course of a cholecystectomy is immediately recognized the respective ends of the divided duct are easily freed from contiguous tissues and an interval of from one to two centimeters bridged over by their anastomosis without undue tension. On the other hand after stricture develops identification and mobilizing the ends of the duct becomes much more difficult and may render some other form of duct reconstruction necessary. Yet even under such unfavorable conditions a considerable interval in one instance reported by Kehr of two inches may be successfully bridged in this way. In other cases the dense and consequently unyielding character of the cicatricial tissue or its peculiar friability or the length of the stricture proper forbid an attempt to secure end to end anastomosis and compel the adoption of other means to restore duct continuity.

In these cases after the excision of the cicatricial tissue a new channel between the exposed orifices of the duct must be provided in the hope that ultimately it will become lined with epithelium and thereby remain permanently patent. The most simple means to attain this result is to introduce a rubber tube into either orifice of the duct with the expectation that the granulation tissue which ultimately invests the tube will when the tube is removed gradually become converted into a satisfactory channel which even though contraction ensues will yet remain sufficiently patent to convey the bile into the intestine. Verhoogen reports a patient treated in this way who was in excellent health 11 months after the operation. A patient operated on by Propping developed prompt recurrence while in Kehr's case the end result is not mentioned.

In two instances the missing part of the duct has been supplied by using the biliary

fistula in one by von Stubenrauch who anastomosed it with the duodenum (failure through necrosis of the fistulous tract) and a second case in which Murphy invaginated the biliary fistula directly into the exposed end of the common duct. In this case the patient remained free from recurrence for 8 months but ultimately died in a condition of advanced jaundice refusing hospital aid. Probably other methods of duct reconstruction are preferable to those just mentioned.

The essential steps in duct reconstruction include the suture of the posterior edges of the divided ends of the duct anchored to the adjacent tissue of the gastrohepatic omentum (chronic catgut sutures). In this way their relative position is kept constant. A soft Nelaton catheter is then introduced into the duct above and below and if possible through the papilla into the duodenum. The exposed portion of the tube indicating the length of the new channel is then covered in by the superposition of a visceral pedunculated flap from the adjacent wall of the stomach or duodenum or gall bladder (in one case Kehr by a portion of the cystic duct remaining after the removal of the gall bladder) or the defect may be covered by a detached fascial flap (Ginsburg and Speese) or by omentum or by bringing over the tube with Lambert sutures the adjacent posterior parietal peritoneum. This last method using plain catgut sutures and reinforcing of the suture line with superimposed omentum is preferred by the writer. The use of omentum alone has not given satisfactory results although in animal experimentation it has been employed successfully for the repair of defects in the gall bladder. The unsatisfactory results in the few cases in which this method has been used for duct reconstruction may have been due to its inherent mobility as well as to the mobility communicated to the omentum by the peristaltic movements of the transverse colon. Free movement of this kind might interfere with the stability of the sutures and with the subsequent patency of the new duct. Flaps from adjacent viscera should not include the mucous membrane for the reason that pathological bacteria on its surface may predispose to an ascending

infectious cholangitis while subsequent leakage may follow faulty repair of the visceral opening. Gall bladder flaps with the mucous membrane turned toward the interior of the reconstructed duct are said to predispose to the formation of new calculi. It must be remembered that any flap prolongs the operation and that in cases where the general condition of the patient is seriously impaired some short and simple method of duct reconstruction is preferable.

The problem is much more complex in strictures involving the end of the common duct. Here relief can be afforded by direct anastomosis between the dilated duct above the point of stricture with either the stomach, duodenum or small intestine or by the formation of a new channel with the assistance of a soft rubber tube which fastened above into the end of the dilated duct is carried through a new opening in that part of the alimentary canal which under favorable conditions would have been selected for direct anastomosis. This form of duct reconstruction must be employed when the stump of the hepatic stump is very short when the intestine is so firmly fixed by adhesions that direct anastomosis would be impossible or when the necessary apposition would cause so much tension that subsequent leakage would be likely to occur.

Analysis of the cases collected by the writer shows that anastomosis of the stump of the divided duct to some part of the alimentary canal was done in 6 cases with the stomach in 18 with the duodenum and in 6 with the jejunum. Of the 6 cases of anastomosis with the stomach one (Dujarier) was in excellent health 3 and another (O'Day) 6 years after the operation. In Kehr's case the operation was followed by both biliary and gastric fistulae of which the latter closed only after the expiration of 11 years. Of the 18 cases of anastomosis of the stump of the duct to the duodenum Summer's case was well 7 years, Bary's and Mann's 4, Crile's 3 and Wilms 15 months after the operation. Duodenal fistulae developed in the case of Losser and closed spontaneously in 3 weeks in the case of McGlannan a biliary fistula developed as well as a fatal termination ensuing

Subsequent attacks of slight jaundice and epigastric pain after the recovery of the patient were mentioned in the cases of Mann and Bottomley.

Of the cases of anastomosis of the duct and jejunum Kausch reports a patient well one year and Jackson one free from jaundice or other symptom of recurrence when the patient suddenly died 11 months after operation for secondary gastric carcinoma.

Lighten cases of duct reconstruction have been collected exclusive of the two reported by the writer. Of these in 9 the lower part of the choledochus was preserved. In the remaining 9 a new opening was made in the duodenum. The methods of reconstruction varied. In 3 (Verhoogen, Propping and Kehr) nature was allowed to form a new duct segment out of granulation tissue. Verhoogen's case was well 11 months after operation. Propping's patient developed symptoms of recurrence shortly after the operation and a stricture nearer the liver discovered on opening the abdomen was treated in the same way as the original stricture. No mention is made of the end result in Kehr's case. Propping's case is of interest in that the segment of the duct originally reconstructed appeared normal when the abdomen was re-opened.

In 5 cases after excision or division of the stricture an attempt was made to form a new channel by suture of parietal or visceral peritoneal tissue over the exposed part of the tube introduced into either extremity of the divided duct. Of these cases Freeman's is most interesting in that the patient died of chronic abscess of the liver 11 months after the operation, an opportunity was afforded to examine the reconstructed duct. It had considerably contracted to the calibre of a broom straw but had functioned satisfactorily without indication of biliary stasis. Of end results Finney's case is noteworthy in being well two years and McRae's 2 and one half years after operation. In the latter case the stricture was treated by incision, dilatation and drainage. Verhoogen and Finney mention the occurrence of slight attacks of jaundice and epigastric pain a number of months after the patient's recovery.

In Voelcker's case the tube allowed to remain *in situ* was found bent and displaced at a second operation for a persistent biliary fistula four months later. To prevent a similar accident the tube was brought out through the duodenum (Witzel) with excellent result.

In the remaining 9 cases a new opening in the duodenum was necessary. In two the exposed tube joining the hepatic stump to the duodenum was covered with omentum. Brewer's patient, after a temporary cholangitis with jaundice, promptly developed a recurrence and succumbed to an operation for its relief. In Terrier's case the recurrence was successfully relieved by an anastomosis between the duct and duodenum. Sullivan, to whom credit is due for the invention of this operation, reports the case of a patient of 60 well and attending to the work of an engineer 4 years after the operation. An equally satisfactory end result was obtained by Jenckel, who bridged by this method an interval of 8 centimeters. This patient developed a duodenal fistula during convalescence which ultimately closed. After recovery the patient suffered from occasional attacks of colic. Wilms reports 4 cases. In the first a slight biliary fistula persisted and the patient suffered from occasional attacks of pain in the right hypochondrium. The second case was complicated during convalescence by a duodenal fistula which required a jejunostomy for its relief. The catheter was discharged from the wound on the eleventh day. Save for a slight biliary fistula the patient was well 15 months after the reconstruction. In the third case, after vomiting a large amount of bile a short time after the operation (proving the patency of the tube) a biliary fistula developed which was found on exploration three weeks after the primary operation to have been the result of the displacement of the tube out of the hepaticus. The tube was then sewed in. Two months later it was vomited. In the fourth case, after the end to end suture over a tube of the ends of the duct, divided in the course of a cholecystectomy, a persistent biliary fistula developed which was found to have been the result of the angulation of

the tube and a consequent separation of the ends of the duct for a distance of 2 centimeters. A Voelcker transduodenal operation then failed to relieve the jaundice and after an interval of 7 months a Wilms operation gave relief for several months at the end of which time the tube was vomited and the jaundice immediately reappeared. At a fourth and final operation the jaundice was relieved by a Wilms operation, a new duct being reconstructed between the hepatic stump and the stomach.

The dangers common to either or both of these procedures include: 1. Leakage of intestinal contents into the peritoneal cavity directly or after the retraction of the implanted end of the duct.

Regurgitation of intestinal contents into the newly formed duct channel.

3. Ascending infection, cholangitis with liver abscess.

Leakage from the retraction of the implanted duct may be prevented by the suture of the end of the duct through a separate transverse opening in the duodenum to the mucous membrane below the opening through which the duct enters the intestine. The additional duodenal opening is then closed in the usual way and the duct sutured to the outer wall of the duodenum at its point of entrance. The wall of the duodenum is then still further infolded upon the terminal part of the duct.

The danger of ascending cholangitis varies directly with the distance from the site of the papilla at which the new opening into the intestine is made. It is therefore least frequent when the opening is made into the stomach near the pylorus or into the upper part of the duodenum. The risk of this complication as well as the risk of subsequent regurgitation of intestinal contents is materially decreased if the end of the divided duct or the rubber tube in case of duct reconstruction is passed obliquely (Witzel) through the visceral wall. The risk of postoperative leakage and the subsequent formation of a duodenal fistula is also diminished by this procedure. It is only in the rare side to side anastomosis that this condition cannot readily be carried out. For the purpose of

still further decreasing the risk of these post operative complications provision may be made for the insertion of the end of the divided duct or in case of reconstruction of the rubber tube into a portion of the small intestine which has been excluded from the path of intestinal contents either by simple enteranastomosis or by a more complicated procedure as follows the intestine is first divided and after the closure of the oral stump the continuity of the intestine is restored by lateral anastomosis a short distance below the point of division. The excluded intestine two or three inches in length above the lateral anastomosis is then utilized for the entrance of the divided duct or rubber catheter and the case may be. While the advantages of this method are evident it must again be emphasized that frequently the general condition of the patient does not permit prolonged operation and that a long pre existing jaundice predisposing to parenchymatous postoperative hemorrhage is not conducive to extensive repair. As a matter of fact while experience as yet is not sufficient to determine the choice of any special method sound judgment would seem to warrant the selection of the more simple rather than of the more complex method unless the patient still has abundant vitality. In many cases in which the adhesions are so numerous and so thick that a considerable time is required adequately to expose the region of the stricture it is wise to do the operation in two stages the first having for its object the establishment of a satisfactory biliary fistula the second done only after jaundice has disappeared and the general condition of the patient has improved for the purpose of effecting duct reconstruction.

Whatever the method adopted the first step in all operations is identical namely to expose and identify the duct above and below the stricture. This is usually difficult on account of the obliteration of anatomical landmarks by adhesions and is consequently fraught with the danger of visceral and vascular damage. The goal to be attained is the gastrohepatic omentum with the foramen of Winslow and the guide which the writer

especially in the absence of the gall bladder has found most serviceable is the under surface of the liver particularly the sulcus originally occupied by that organ. From this surface all adhesions including those binding the omentum to the stomach duodenum and colon are carefully separated keeping close to the liver until its transverse fissure is reached. Separating at first with considerable difficulty and requiring the ligation of numerous bleeding points the adhesions yield much more readily as the transverse fissure is approached. With the exposure of the gastrohepatic omentum the pulsation of the hepatic artery forms a valuable guide to the position of the dilated duct. The identification of the collapsed duct below the stricture is much more difficult but the upper border of the duodenum and the edge of the gastrohepatic omentum serve as important guides. In all strictures in which the end of the duct are separated by an appreciable interval the duodenum should be mobilized. This maneuver in some cases will permit in end to end anastomosis of the ends of the duct without tension while in others it will render possible in end to side anastomosis of the hepatic stump and duodenum.

The disposition of the Nelton's catheter used in cases of duct reconstruction is of great interest. By some it has been left *in situ* and in the *e* cases it has either been ultimately passed in the stool or remained *in situ* for several months it has been vomited. In several instances it has become displaced or angulated in such a fashion as to block the flow of bile. By other surgeons some device has been employed by which after a certain length of time the tube has been removed. This may be accomplished by the use of a T tube the vertical portion of the tube being left out of the wound at the end of the operation or the vertical part of the tube may be supplanted with two loops of stout silk tightly embracing the catheter in the reconstructed part of the duct and emerging from it between two catgut sutures. At the end of a variable period the tube is withdrawn by gentle traction on these loops. Voelcker objects to this procedure because

of the damage inflicted by the withdrawal of the tube on the wall of the newly reconstructed duct and to obviate that disadvantage he urges that the extremity of the tube be brought out obliquely through the wall of the duodenum a short distance below the old or the newly made papilla to subsequently emerge with the drain through the abdominal incision. At the end of 10 to 14 days the tube is removed and not replaced and the oblique small opening in the duodenum promptly closes.

If the common duct below the point of repair is normal and accessible Voelcker prefers to bring the tube out through a small opening in this part of the duct rather than through the duodenum. Other observers have practiced the withdrawal of the tube through a small opening in the wall of the hepatic duct above the reconstructed segment. Either of these measures seems preferable to the withdrawal of the tube through an opening in the duodenum subject as it undoubtedly is to the possibility of a duodenal fistula. In fact in at least one instance reported by Voelcker this disagreeable complication has occurred although fortunately the fistula closed spontaneously without detriment to the patient. In the writer's second case after reconstruction of the duct by the use of the posterior parietal peritoneum the tube was withdrawn without difficulty 4 1/2 weeks after the operation by gentle traction on the silk ligatures. That this occasioned slight if any damage to the wall of the newly reconstructed duct is evidenced by the fact that its withdrawal was followed by the discharge of a very small amount of bile which continued for 12 hours and then completely and permanently ceased. Whether then the use of this method favors in any way a recurrence of the stricture must remain doubtful. Theoretically at least the scar which ultimately closes the opening through which the tube had emerged is more advantageously placed either above or below than in the reconstructed portion of the duct itself.

The period during which the tube should remain in the duct varies very materially. By some as has been mentioned no attempt

is made to remove the tube and it is supposed to remain indefinitely if not vomited or passed in the stool. By others provision is made for its removal in from ten days to five weeks after the operation. The writer believes that if the tube is left *in situ* for four or five weeks the process of epithelialization is more advanced and consequently the danger of a recurrence of the stricture correspondingly less than in those cases in which the tube is left in for a shorter time. While the tube is *in situ* the bile either flows through it or alongside of it into the intestine or out through a biliary fistula in the abdominal incision or in both directions simultaneously. The tube should be of sufficient size moderately to fill the duct without undue distention. Its possible dislocation should be prevented by chromic gut sutures between it and the edges of the duct orifices.

Stricture of the hepatic duct so situated that the dilated duct above lies entirely within the transverse fissure and therefore is inaccessible to the surgeon presents a most difficult problem. The obstacle can be relieved by hepatostomy a biliary fistula being made by puncture of the liver parenchyma with the actual cautery. Subsequently the tract of the biliary fistula can be carefully dissected out and anastomosed to some part of the intestinal canal or both steps can be done in one operation the intestine being anastomosed directly to the punctured liver tissue or the liver tissue may be punctured by the cautery through the contiguous wall of the gall bladder utilizing the opening through which this is done for subsequent anastomosis with the intestine. A successful case treated in this way by Scheidler was well 5 months after the operation. Anastomosis directly of the duodenum to the punctured liver tissue has been done successfully by Doberer who makes no mention of the end result and by Garre.

In Garre's case a boy operated on for traumatic subcutaneous stricture of the hepatic duct was in excellent health three years afterward. Whether in this case the hepatic duct remained permanently obliterated or whether as some have suggested it again became patent is a question that only

autopsy could decide. Experimentally it appears impossible to prevent granulation tissue from blocking the mouths of the smaller biliary passages that have been opened by the actual cautery and so from obstructing the flow of bile. That such openings may remain permanently open in the human species however is shown by the case of Lameris who had an opportunity of examining the condition of the anastomosis 8 months after hepato enterostomy for obstruction of the hepatic duct. In this case there were 10 small openings lined with cylindrical epithelium leading into the intestine from the right lobe of the liver from which bile could be made to exude by pressure. The patient had died from multiple infection of the liver so that this operation is subject to the same danger of an ascending cholangitis as any other variety of anastomosis between the gall duct, gall bladder and intestine. On the other hand the experience of Kausch who after a successful hepato-stomy was obliged at intervals of from ten to 14 days to remove the granulations from the surface of the liver in order to effect a renewal of the flow of bile demonstrates that a biliary fistula established in this way is not always permanent. To account for the evident discrepancy in the result of this operation the writer suggests that the biliary fistula may be temporary when the patency of the hepatic duct becomes reestablished but that if the hepatic duct is completely obliterated the intrahepatic biliary pressure may be sufficient to insure permanently the flow of bile through the new channels which hepato-stomy provides. But even if biliary fistula made by puncture or by division of liver tissue are only temporary the operation may yet prove of decided benefit by relieving a congested condition of a stricture in an inaccessible hepatic duct while the liver fistula may remain open sufficiently long to permit the reestablishment of a biliary fistula in communication with the duct and in at least one instance to provide in this way an outlet for the discharge of calculous material by which the duct was obstructed. Thus in the case reported by Cohen a hepato-stomy was done for jaundice persisting after a

cholecystectomy in which the duct was inaccessible. After 48 hours the liver fistula discharged copiously and continued to do so for 6 days. Then bile passed into the intestine and the original fistula remaining after the cholecystectomy discharged a large amount of calculous material and shortly after closed the liver fistula having previously closed as soon as the duct again became permeable.

The discussion of benign stricture of the common and hepatic ducts in this paper has referred to a lesion in the final stage of its development. The stenosis must be extreme seriously to interrupt the flow of bile into the intestine. Were the bile duct as accessible to examination as the urethra the sequential development of the symptoms of stenosis together with the essential principles of their treatment would have become thoroughly standardized. As it is the clinical features in primary cases are not easily differentiated from those of stone in the common duct even in the stage of permanent jaundice and it is for the removal of a supposed stone that the operation is usually undertaken.

It is only in a lesion associated with stone that partial stricture of the duct is occasionally observed by the surgeon. Whether such a stricture requires special treatment is not always easy to decide. Usually the removal of the stone or stone leaves the duct in such a condition that any further increase in the degree of stenosis is improbable. When a small part of an accessible portion of the duct is involved in this way and the stricture is composed of dense cicatricial tissue and is annular its resection with end to end anastomosis is justifiable. Strictures in the lower inaccessible portion of the duct at or near the papilla the presence of which are suspected because the passage of an instrument through the opened duct into the duodenum is impossible do not ordinarily justify duct reconstruction. Usually such strictures are due to the inflammatory swelling and edema of an associated cholangitis which the removal of the calculus and the subsequent postoperative biliary drainage relieve. On the other hand the

failure of bile to flow after the removal of a calculus in the hepatic duct is evidence of a stenosis which demands immediate relief and the operation should not close until an ample flow of bile is secured. Sometimes a stenosis is due to the presence of a second calculus higher up and sometimes to cicatricial stricture. In the latter event endeavor should be made to pass a probe through the stricture to be followed either by its division or if situated in a part of the duct surrounded by liver tissue by its dilatation with long slender forceps. A lesion of this kind herewith reported has recently been treated by the writer. The stricture situated in the duct within the transverse fissure was treated in the manner just described by dilatation followed by the establishment of an ample biliary fistula and a disappearance of the jaundice. Apart from a subdiaphragmatic abscess the post-operative course was satisfactory. Four weeks after the operation the stools contain a considerable amount of bile although much was still discharged through the fistula. The patient ultimately succumbed to pneumonia 56 days after operation the biliary fistula having been closed for several weeks (See Case 3).

Any comparison of the relative value of the methods of duct reconstruction is very unsatisfactory. The question as yet unanswered is that of the possibility of the production of an epithelial lining for the new passageway. If this actually takes place it may be expected with reasonable assurance that a lining of this character will provide a safeguard against a recurrence of the stricture. Unfortunately this question must still remain doubtful for its solution could only be supplied by the actual microscopical examination of the lining wall of the new channel after operations for duct reconstruction where the patient has remained free from recurrence sufficiently long to be considered a permanent cure. A careful search of the literature has failed to reveal any evidence of this kind.

Apart from the necessity of providing if possible a channel which will not materially contract the advantages of utilizing the terminal part of the common duct are

quite evident. A normal papilla is in itself the best safeguard against intestinal ascending infection and its sphincteric control of the passage of the bile into the duodenum cannot be imparted to any artificial opening no matter how skillfully made. Furthermore, the dangers of duodenal leakage or of regurgitation of intestinal contents into the newly reconstructed duct are naturally avoided if the wall of the duodenum remains intact. When however the lower part of the common duct is the site of stricture a new opening in the duodenum is unavoidable. In that event it is the writer's belief that end to end anastomosis between the dilated duct and the duodenum through an oblique (Witzel) opening in its wall will prove the method of choice. In all cases where pathological conditions preclude direct anastomosis an effort should be made to reconstruct the duct by means of a rubber tube which sutured by absorbable material to the duct wall and covered by the contiguous visceral or parietal peritoneum is passed obliquely into the intestine or stomach as near the papilla as possible.

AUTHOR'S CASES

CASE I. Gussie Schwartz female admitted to the Presbyterian Hospital November 27 1907. Patient had typhoid at 12. Five months ago patient first had cramps in the right upper quadrant radiating at times upward along the anterior chest wall. These occurred three or four times a day and were associated with vomiting constipation and clay colored stool without jaundice.

Physical examination showed slight rigidity and marked tenderness in the right upper quadrant with a sense of a mass in the neighborhood of the gall bladder. A cholecystectomy was done for a chronically atrophied gall bladder filled with stones. For a month after the operation there was a profuse biliary discharge the jaundice which had developed prior to the operation decreasing but not disappearing. Six weeks after the operation the biliary fistula had closed and the patient was entirely free from jaundice and left the hospital.

Six weeks ago the jaundice again appeared and has since increased without pain but with some epigastric distress. On examination there is slight tenderness on deep pressure in the upper angle of the scar. The jaundice is intense and deepening. The stools are clay colored. The time coagulation of the blood is below normal and not materially affected by calcium chloride.

Under gas ether anesthesia the pararectal scar

was excised and the incision lengthened toward the median line. The gastrohepatic mentum buried in adhesions was exposed by pulling lowly back and along the under surface of the liver to the transverse fissure. The common duct was then identified in the upper left portal nail open. A probe passed readily to the duodenum. In the opposite direction probe entered a structure in the hepatic bed that ran in the lower the transverse fissure and a distance of three quarters of an inch in the direction of the liver. It was a glandular structure in my opinion. The duct duct in the liver. The opening into the duct was filled by a profuse discharge of bile. After that as introduced into the hepatic duct and brot out through the abdominal wall.

After the operation the bile was discharged from the biliary tract. The jaundice gradually diminished and ultimately disappeared. The transverse fissure of the liver showed the slightest trace of the pigment. On the anterior surface of the mouth of the gallbladder a small rise of temperature which was quickly abolished when the biliary fistula was reestablished. The case as some patients follow temperature and gradually diminishing for several weeks after the operation. During the second and third month of convalescence the temperature was normal though jaundice had not yet disappeared. The general condition of the patient was fine. There was no fever. The diet consisted of thin gruel and fruit. The biliary fistula closed and the patient was discharged in a complete recovery from both jaundice and pain.

One year after the discharge the patient suffered from a slight attack of indigestion with jaundice for the treatment of which she was admitted to the hospital. This quickly subsided in a few days with the administration of phosphate of soda. Several months afterward it was learned that the patient had moved out of the city and she has since failed to communicate with the hospital.

CASE. M. I. aged 35 years. Admitted to the Lawrence Hospital April 1905. Ninety years ago to months after a fracture of the ribs from a fall on the right hip bone the patient had an attack of gallstone, lasting a half hour and not accompanied by either nausea or vomiting. Several attacks occurred at various intervals until 3 years ago when a prostration either a holocaust or a cholera was done in another hospital. The gall bladder was buried in adhesions and on escape was prolonged by a right sided pneumonia and pleurisy.

Fourteen months after operation a hernia first appeared in the scar and since then has steadily increased in size.

For 18 months after the operation the patient had no further attacks of colic. At that time however she began to suffer from attacks of soreness in the gall bladder region without actual colic pain but with chills, sweating, weakness, moderate temperature and marked jaundice with clay color of stools. There was never any vomiting or gastric or digestive disturbance and the movements of the bowels were easily regulated by salts. During the attacks the patient attained a state that the liver seemed larger and more sensitive. Between the attacks the patient's general condition was good and her appetite excellent. She had never regained her normal weight since the operation weighing about 30 pounds less.

Physical examination shows a cicatricial scar in the gall bladder region which is the site of a vertical incision 4 inches in length. The abdominal wall distended and a lively peristalsis palpation of the liver through the right lobe being 2 inches below the transverse fissure and the left lobe being almost fully enlarged. There is slight sensitiveness in the region of the gall bladder and the patient is also palpable and tender. There is no perceptible jaundice or bile in the urine. The leucocytes were not increased.

Under ether anesthesia the abdominal scar was excised and the edges of the abdominal aponeurosis freed and preparatory to an overlapping for the closure of the central hernia in the closure of the abdominal incision. The peritoneal cavity was opened through the right difficulty owing to extensive adhesions of the omentum the transverse colon through the duodenum and the pyloric end of the stomach. The different structures were gradually identified as the adhesions were divided the gastropyloric omentum being exposed after a careful dissection of the under surface of the liver as far as the transverse fissure. There was not a fever of the gall bladder. The hepatic artery was first identified and secured as made for the duct in the right side. The hepatic end was first found matted in adhesions and contained a large amount of bile which was evacuated from the end as the adhesions were freed. At a distance of three quarters of an inch below the end of the hepatic duct the common duct was found. It appeared collapsed but readily admitted a catheter which was passed into the duodenum. The entire liver was jaundiced and presented the gross changes of a liver which had been subjected to a long standing biliary stasis. The absence of general jaundice however indicated that bile must have found its way into the intestine across the interval between the ducts although the escape of bile could not be demonstrated. On the other hand however the appearance of the liver indicated bile stasis which was caused by the long accumulation of bile in the hepatic duct. It is highly probable that the liver lost its power to perform the function of a reservoir. Probably because of long standing structure the dilatation of the duct causes a species of tolerance.

for the accumulation of bile without the occurrence of actual jaundice until obstruction shall have become complete

The posterior edges of the divided ducts could not be approximated closely by suture an interval of perhaps half an inch still intervening after the insertion of plain catgut sutures. The point of the catheter still remaining in the duodenum the opposite end was introduced several inches into the hepatic duct. Two ligatures of stout silk were then tied around that part of the catheter which was exposed in the interval between the divided ducts and brought out through the abdominal incision. From either side of the exposed portion of the catheter the peritoneum was brought up and approximated over it by catgut sutures in several layers so that the catheter was completely hidden from view. The abdominal wound incision was then closed by the overlapping method a cigarette drain having previously been introduced along the path of the silk ligatures.

For the first two or three days after the operation there was some discharge of bile from the wound. This rapidly ceased and was not renewed with the withdrawal of the drain. The bile promptly appeared in the stools in increased quantity. At the thirty second day under laughing gas the rubber catheter was easily withdrawn from the duct and without any decided or prolonged discharge of bile. The wound promptly healed and the patient has been free from all discomfort for the past six months.

During this interval however there have been several short attacks of jaundice with epigastric pain and fever which have promptly subsided and have interfered in no way with the general condition of the patient. December 1, 1917, patient still free from recurrence.

CASE 3. Male age 4 admitted to the Presbyterian Hospital March 14, 1917. Since 1914 the patient has had from 15 to 20 attacks of abdominal pain and distress similar to the present one. The previous attacks have been associated with jaundice the present one not. With each attack after a gradual onset the patient has suffered from constant boring pain in the upper right quadrant radiating to the right shoulder and back. It has had no relation to meals and has been neither intensified nor alleviated by the movements of the patient. There has been nausea and vomiting with one chill fever and malaise. The patient has lost 15 pounds in weight in the last two years. Between the attacks the patient has had the feeling of a lump in the epigastrium. There has also been belching of gas and chronic constipation.

Physical examination. The patient is thin and poorly nourished and nervous. There is tenderness and rigidity in the right upper quadrant in the region of the gall bladder. The liver edge is 5 centimeters below the free costal margin. The gall bladder is palpable.

Leucocyte is 1000 with 64 per cent polymorphonuclears. Blood coagulation time was three minutes.

Gastric analysis showed total acidity of 15 per cent with 25 per cent free hydrochloric. Urine normal. Wassermann test negative. No radiographic evidence of gall stones.

Operation. On opening the abdominal cavity through a transverse incision a large gall stone was found in the hepatic duct close to the transverse fissure of the liver so tightly impacted as to require the aid of a scoop in its removal. After the removal of the stone bile could be made to issue from the incised hepatic duct by pressure on the gall bladder but no bile appeared from the liver. A probe introduced upward into the hepatic duct encountered an obstruction consisting in part of calculous material. There was also a marked stenosis in the lumen of the duct on passing through which bile gushed from the upper portion of the duct.

A pair of slender forceps was then introduced through the stricture with considerable difficulty and the duct stretched so as to admit a Nulaton's catheter 20 French. This was left *in situ* and brought out of the abdominal incision. The gall bladder was then removed. On ninth day after operation the catheter was removed followed by the appearance of some bile in the stools although the greater part passed through the biliary fistula. On the twenty third day after operation the patient developed the symptoms of a subphrenic abscess which was opened in two stages. By the thirtieth day after operation the discharge from the biliary fistula was slight but still contained as it had for the preceding two weeks a certain amount of calculous detritus. At this time a small collection of pus in the outer angle of the abdominal incision was opened.

During the next three weeks the patient had physical signs of a bronchopneumonia slight in character which would disappear and then recur.

On the fifty sixth day after operation the patient developed a marked swelling in the lower right iliac fossa. An exploration showed the intestine matted together but no sign of pus. Twenty four hours after this exploration the patient developed symptoms of pulmonary oedema from which he died on the sixty first day after operation. Unfortunately no autopsy could be obtained. At the time of his death the biliary fistula had closed and the stool were of normal color. The last exploratory incision however was followed by the appearance of bile (but no pus) in the dressing.

ABSTRACTS OF CASES COLLECTED IN LITERATURE AND FROM PERSONAL COMMUNICATION

EXCISION OF SMALL PORTIONS OF THE DUCT WALL (NOT COMPLETE DIVISION)

Kehr reports five accidents of this character during cholecystectomy all of which recovered and remained permanently well with the use of a T tube. Kehr also reports a linear defect of the hepatic duct in the course of a cholecystectomy in which a stricture subsequently developed lower

do not in the common duct which he believes was also damaged during original operation. Recovery.

Breve reports a ligation of the junction of the cystic and common ducts in the course of a cholecystectomy, narrowing the lumen of the latter duct one third. The ligation was also found to remain *in situ* without any untoward result. The same surgeon also reports a case in which the removal of a villous growth from the interior of the common duct narrowed the lumen one third. The resulting gap was closed by suture together with the incision in the wall of the duct without indication of subsequent trouble.

IMMEDIATE END TO END ANASTOMOSIS FOR REPAIR OF DIVISION OR PARTIAL EXCISION OF PORTIONS OF THE COMMON OR HEPATIC DUCTS

CASE 1. Reported by Jackson. Excision of a portion of the duct in hospital, leaving an interval of one inch. About a year later well in months after.

CASE 2. Reported by Koert. Suture after division of a stricture. Well in a year.

CASE 3. Reported by Koert. Excision of a stricture associated with a tumor. Suture of duct end on a rubber tube which was placed through an opening in the hepatic duct. Recovery.

CASE 4. Reported by Koert. Excision of the junction of cystic and hepatic ducts. About a year later. Immunity. Recovery.

CASE 5. Reported by Nothmann. Division of the junction of the cystic and hepatic ducts due to absence of cystic duct. Immediate suture. Recurrence of jaundice in a few weeks. Further operation in which the tumor of the hepatic duct was anastomosed to the jejunum. Recovery.

CASE 6. Reported by Stine. Immediate suture for divided duct in course of cholecystectomy. Recovery.

CASE 7. Reported by Kehr. Defect in hepatic duct closed by the Heineke Mikulicz method. Six months after excision of a stricture. Suture. Recovery.

CASE 8. Reported by Kehr. Defect in hepatic duct closed by the Heineke Mikulicz method. Six months after excision of stricture. Suture. Recovery.

CASE 9. Reported by Voelcker. Immediate suture of a rubber tube for excision of junction of hepatic and cystic ducts during cholecystectomy. Tube brought out through separate opening in the choledochus below point of repair. Recovery.

CASE 10. Reported by Doberauer. Interval of 4 centimeters in common duct after excision of a carcinoma. Suture of a rubber tube which was removed 11 days after by forceps. No recurrence of jaundice. Patient died from gastric recurrence three months after. Autopsy.

CASE 11. Reported by Volckner. In case operated on by assistant excision of the junction of the

hepatic and cystic ducts during cholecystectomy. Similar procedure to above. Recovery.

CASE 12. Reported by Jack. Six months after a cholecystectomy by another surgeon the patient developed persistent jaundice and epigastric pain. Operation revealed a suspicious looking adenoma of the common duct which was widely excised. The divided ends were sutured with some tension over a rubber tube, the point of suture being reinforced by omentum. The tube was passed on the sixteenth day. Sixteen months later the patient's condition was very satisfactory save for the occurrence of slight attacks of jaundice and epigastric pain at increasing intervals.

CASE 13. Reported by Jopson. End to end suture after division of the lower part of the choledochus during the excision of an extensive cancer of the pylorus. The patient was well 2 1/2 years after and without sign of recurrence.

CASE 14. Reported by Hotchkiss. Accidental transection of the common duct closed by end to end suture. Complete recovery.

CASE 15. Reported by Lyle. In a cholecystectomy a portion of the common duct was excised. In immediate end to end suture. Sutures did not hold and a persistent biliary fistula developed with abdominal pain. Six months later an operation for reconstruction of the duct was done (see duct reconstruction).

CASE 16. Reported by Stettin. Duct divided during cholecystectomy. Approximation of divided ends not difficult. End to end suture reinforced by omentum. Gradual closure of biliary fistula. Recovery.

CASE 17. Reported by Potter. Resection of a portion of the retroduodenal choledochus for benign tumor followed by end to end anastomosis. Discharge of bile above site of suture. Death seventh day from cholera. Sutured duct shown by autopsy to be in satisfactory condition.

CASE 18. Reported by A. W. Relius. Division of common duct during cholecystectomy by another physician. Operation 6 weeks later showed that the junction of cystic, hepatic and common ducts had been excised and that the stumps were epaated by an interval of 1 inch. End to end anastomosis reinforced by omentum. Recovery. No mention of edema.

EXCISION OF STRICTURE FOLLOWING DAMAGE TO THE COMMON OR HEPATIC DUCT WITH END TO END ANASTOMOSIS

CASE 1. Reported by Kehr. Excision of stricture 1 centimeter in length 10 and one half months after tear in hepatic duct. Suture. Recovery.

CASE 2. Reported by Kehr. Excision of junction of the hepatic and cystic ducts during cholecystectomy. Six months later excision of stricture release of the common duct and bridging over interval of 1 centimeter by suture.

CASE 3. Reported by Kehr. Empyema of gall bladder. Suture of the common duct at junction

of cystic Cholecystectomy Excision of stricture followed by end to end suture Recovery

CASE 4 Reported by Kehr Excision of suspicious mass at junction of hepatic and cystic ducts leaving an interval of about 2 inches End to end suture Two months later symptoms of stricture Operation excising stricture of 2 centimeters Recovery Well 6 months afterward Mass showed no sign of cancer

CASE 5 Reported by Voelcker Division of common duct in cholecystectomy Twenty four days after end to end anastomosis over rubber tube which was carried down into duodenum and out through the wall by Witzel method emerging with the drain through the abdominal incision No leakage Tube removed on fifth day Recovery

CASE 6 Reported by Kehr Excision of old stricture End to end suture supplemented by a hepatocholedochoduodenostomy Recovery

CASE 7 Reported by Riggs No previous operation Stricture at the junction of the hepatic and cystic ducts Resection of the stricture End to end suture bridging interval of 3 centimeters Temporary biliary fistula Well $4\frac{1}{2}$ years after operation

CHOLECYSTENTEROSTOMY

CASE 1 Reported by Mafraani Biliary fistula following cholecystostomy anastomosed to pylorus Well years afterward

CASE Reported by Koerte Duodenocholecystostomy for apparent stricture of the papilla Recovery

CASE 3 Reported by Kausch Cholecystenterostomy with enterostomosis for supposed cancer of the pancreas Death 3 months later from an infectious cholangitis Autopsy disclosed a chronic pancreatitis There was no indication of biliary stasis In this connection Kausch believes that the more steady flow of bile into the intestine after anastomosis between the duct and the intestine presents a greater obstacle to possible ascending infection

CASE 4 Reported by Hotchkiss Accidental division of the common duct near its termination in the duodenum in connection with the removal of a pedunculated pancreatic cyst Attempt at closure with a musculoperitoneal flap from the pylorus failed Ultimately a cholecystenterostomy was done ligating with catgut the common duct on the proximal side of the biliary fistula For this purpose a Murphy button was used The patient remained well one year after although in the meantime he had developed diabetes

CASE 5 Reported by Delatour History of a cholecystostomy followed by a choledochotomy followed by a persistent biliary fistula At operation by Delatour the middle of the common duct which at the previous operation had been divided transversely presented a stricture and cholecystenterostomy with Murphy button was done the opening in the duct being closed with silk The

patient made an excellent recovery The end result could not be ascertained

CASE 6 Reported by Stanton The author states that in several cases of simple stricture of the common duct and the gall bladder was available and that a cholecystenterostomy gave excellent results

ANASTOMOSIS OF DUCT TO STOMACH

CASE 1 Reported by Dujarier Anastomosis of choledochus to stomach for stenosis due to chronic pancreatitis or a benign stricture Silk employed Well three years afterward

CASE Reported by Kehr Anastomosis between hepatic duct and stomach for stricture of entire choledochus There had been no previous operation Gall bladder surrounded by adhesions Recovery

CASE 3 Reported by Brunner A successful case of choledochogastrostomy No detail

CASE 4 Reported by O'Day Patient gave a history of repeated attacks of colic the jaundice subsequently becoming persistent On operation a fistulous tract was found leading from the perforated duct to the lesser peritoneal cavity which was shut off from the greater cavity by obliteration of the foramen of Winslow In the lesser cavity was found a considerable amount of bile containing one calculus During an attempt to free the choledochus it broke off at a point just above the adherent mass in which the termination of the duct was imbedded and abundant bile exuded from the proximal end An anastomosis was done between this stump and the anterior wall of the stomach in its lower one third The gall bladder was obliterated and was not disturbed Recovery Six years after the patient was in excellent condition without indication of any disturbance of digestion

CASE 5 Reported by Quenu and Tuffier Anastomosis between the hepatic duct and the stomach No details

CASE 6 Reported by Kehr (referred to by Kausch) Cholecystectomy followed by persistent biliary fistula Anastomosis between the pylorus and the stump of the cystic duct followed by both biliary and gastric fistulae the last closing only after an interval of 11 years

ANASTOMOSIS OF DUCT TO DUODENUM

CASE 1 Reported by Bazy (discussion of case of Dujarier) Hepatoduodenostomy for probable stricture of the papilla Patient well 4 years afterward

CASE 2 Reported by Mann Two years after cholecystectomy anastomosis between the end of the hepatic duct and duodenum the wall of which was infolded around the tube The lower part of the common duct was apparently obliterated Fate of tube uncertain Recovery Patient well $3\frac{3}{4}$ years afterward Occasional attacks of jaundice and epigastric pain at increasing intervals

CASE 3 Reported by Kehr Immediate hepatoduodenostomy after accidental excision of 6 centi

meters of hepatic and common ducts during cholecystectomy. Through a second incision in the duodenum the end of the duct was sutured to its lining mucous membrane. Kehr prefers this procedure to anastomosis with tube as advocated by Wilms.

CASE 4 Reported by Terrier. After failure to reconstruct with omentum hepatoduodenostomy was successfully done. Post-operative. No detail.

CASE 5 Reported by Terrier. Hepatoduodenostomy for a chronic enlargement of the pancreas. No detail.

CASE 6 Reported by Lese (report by Voelckler). Hepatocolicoduodenostomy for stricture of the choledochus following cholecystectomy, the tube being brought out through a second opening in the duodenum and emerging from the abdomen with the tampon. Reoperation complicated by a duodenal fistula. The fistula closed spontaneously after the tampon. The fistula closed spontaneously in three weeks.

CASE 7 Reported by Terrier. Hepatocolicoduodenostomy after stricture of the common duct following a series of operations, namely, cholecystectomy, cholecystectomy and then plasty operation on the common duct. Post-operative. No detail.

CASE 8 Reported by Kehr (Cholecystectomy). Denoted by the true following: Cholecystectomy with a second incision in the duodenum. The duct was sutured to its lining mucous membrane. The patient died three days after operation.

CASE 9 Reported by McCallan. Persistent biliary fistula after cholecystectomy due to stricture of choledochus near head of pancreas. Direct anastomosis over rubber tube with duodenum. Both biliary and duodenal fistula closed and patient died. No autopsy.

CASE 10 Reported by Bottmeyer. For three years attacks of pain in the upper right quadrant with vomiting and jaundice which persisted up to five months ago and then gradually faded away. Chills and sweating, with recurrent attacks. Exploration through a Bevan incision found gallbladder containing a moderate amount of pus and two stones. The common duct dilated to the size of a tricture. It contained abundant bile mixed with pus. Through an opening in the duodenum the ampulla could not be found. A catheter was introduced into the dilated duct above and the duodenal orifice below. The remains of the duct sutured to the dilated duodenum over all. Cholecystectomy. Recovery without leakage. Tube passed in nine days. Well for 10 months. Then two attacks of slight jaundice with chills, sensations and some epigastric pain of short duration.

CASE 11 Reported by Smeers. No post-operative. Cholecystoduodenostomy with Murphy button for stricture of the end of the duct. Operation supplemented by cholecystectomy. Button was never recovered. Well 7 years after operation.

CASE 12 Reported by Crile. After prior cholecystectomy a complete stricture developed in the common duct from the point of drainage to the ampulla. Excision of stricture. Opening in the outer margin of the duodenum after mobilizing Stump of duct drawn down through opening made from within in the location of the papilla and both sutured on the outer and inner aspect of the incision. Patient well 3 years afterward.

CASE 13 Reported by Wilms. No previous operation. Stones removed and sclerosing stricture of the lower part of the common duct with an indurated pancreas. Anastomosis of the divided end of the choledochus over a rubber tube with the duodenum. Attempt to remove the tube by traction on a loop of silk passed with the tube into the duodenum and out through an opening lower down to emerge with the drain failed. Roentgenogram showed no tube. Weeks after operation. Patient well 15 months afterward.

CASE 14 Reported by Cochet (referred to by Kaus). The patient is said by Gosset to have implanted the choledochus in a new duodenal opening for stricture of the upper part of the ampulla. (CASE 15 Reported by Tilden). Reaction of adhesion of the common duct followed by choledochoduodenostomy. No detail of end result.

CASE 16 Reported by M. Arthur. The patient underwent a series of operations for previous cholecystectomy and cholecystectomy in another clinic had a third unsuccessful operation for the epigastric stricture of the duct (abandoned on account of the hemorrhage). The patient came to the hospital for a third time. The biliary fistula which occurred closed and brought on jaundice. Operation by M. Arthur. The fistula led to the proximal stump of a previously divided duct at the middle of the original common duct. The distal portion of the duct was not recognizable. There was a moderate biliary cirrhosis.

An anastomosis was made between the proximal stump and the duodenum over a rubber tube 8 inches long in which the proximal end was applied with a flange as inserted in the hepatic duct. The remainder of the duct protruded into the duodenum. The flange was secured to the duodenum by a large operating needle. The patient died of a small fibromyosarcoma of the stomach (Operation in 1908).

CASE 17 Reported by M. Arthur. The patient had had cholecystectomy a later drainage of the common duct for persistent jaundice (by atheroma). On operation by M. Arthur a stricture was found in the common duct between the point of drainage and the biliary anastomosis between the duct above the point of stricture and the duodenum as done in the same way as in the preceding case. The patient survived 10 years after the operation and since then has not been traced. (Operation in 1908).

CASE 18 Reported by G. L. Davenport. Chole-

cystostomy Ten months later jaundice with loss of weight On operation obstruction of terminal part of choledochus by the swelling of a subacute non suppurative pancreatitis Side to side anastomosis between common duct and duodenum using a rubber tube Gall bladder much shrunken and cystic duct not patent Drain to region of anastomosis No leakage Prompt union of wound Excellent recovery

ANASTOMOSIS OF DUCT TO JEJUNUM

CASE 1 Reported by Nordmann After unsuccessful suture of ends of the divided duct (ec anastomosis of duct) anastomosis between hepatic stump and jejunum with loop excluded by simple entero anastomosis through a Witzel opening The tube was brought out of the jejunum through a second opening (Witzel) lower down and emerged from the abdomen with the drain Point of entrance of the tube into jejunum strengthened by omentum Recovery

CASE 2 Reported by Jackson Removal of cancer of pylorus which in view of possible stricture of the common duct was supplemented by cholecystotomy At a later operation anastomosis between the hepatic stump and a jejunal loop brought up in front of the transverse colon was done over a rubber tube the common duct having developed an impassable stricture for a distance of several inches The jejunal loop was sutured to both liver and pancreas and was infolded over the tube as it passed through its wall Patient made an excellent recovery but died from a sudden gastric hemorrhage 11 months afterward No autopsy

CASE 3 Reported by Kausch Anastomosis between choledochus and the narrowed end of a divided loop of excluded small intestine Well one year after

CASE 4 Reported by Dahl Modified proceeding of Kausch in that the divided end of the excluded loop was brought up through the transverse mesocolon and sutured to the gastrohepatic omentum the hepatic duct being then anastomosed to its narrowed orifice Recovery with a temporary fistula

CASE 5 Reported by Bales Choledochus was divided in the course of a Billroth II operation for cancer of the pylorus The divided end was brought through a small opening in the jejunum and fastened to the opposite wall by suture Death from pancreatic necrosis Duct in excellent condition

CASE 6 Reported by Linderlen (referred to by Kausch) Cholecystostomy and then cholecystectomy Subsequent stricture Jejunum anastomosed to the stump of the hepatic duct after being sutured to the thickened liver capsule Death 10 days later from hemorrhage due to a needle puncture of the hepatic artery

ANASTOMOSIS OF A BILIARY FISTULA WITH DUODENUM

Reported by von Stubenrauch Anastomosis of a biliary fistula after its dissection from surrounding

tissues with duodenum The fistulous tract necrosed and subsequently an operation was done in which a new duct was successfully supplied by a plastic method

ANASTOMOSIS OF A BILIARY FISTULA WITH DISTAL END OF THE COMMON DUCT

Reported by Murphy Female 46 History of three operations for gall stone difficulty in the last years On admission there were two biliary fistula and one facial fistula in the upper right quadrant together with numerous scars and a ventral hernia On operation no trace of the gall bladder could be found The fistula leading into the large bowel was excised and closed The double biliary fistula joined at some little distance from the abdominal wall and the channel thus formed ran parallel and adjacent to the common duct At a point relatively free from adhesions the biliary fistula was divided and its end telescoped into the distal portion of the common duct Dr Murphy continues The patient left the hospital four weeks after operation There was still some bile in the urine but there was also bile in the stool Both biliary and fecal fistulae were completely closed Two months after her discharge the patient was attending to her household duties She was not yellow There were two sinuses discharging creamy pus in the right side suggesting the possibility of a foreign body She declined to enter the hospital Two months later she complained of pain in the right upper quadrant The sinuses had closed but there was still a large ventral hernia The skin showed a slight lemon tinge There was no bile in the urine and there was bile in the stools She left the hospital against advice and later was said to have died from a recurrence of the jaundice This reconstructed common duct certainly functioned for about six months

RECONSTRUCTION WITH VISCERAL FLAP

CASE 1 Reported by Walton Choledochotomy for pancreatic obstruction Three weeks later a tube was passed from the end of the common duct into the orifice of the duodenum made by the raising of a pedunculated flap consisting of all of its layers which was turned upward in such a way as to completely encircle the exposed portion of the tube The duodenal opening was closed up to the tube Recovery No leakage Ultimate result not stated

CASE 2 Reported by Kehr Cholecystostomy by another surgeon the jaundice persisting Kehr found an atrophic gall bladder with stricture in the supraduodenal part of the duct which was excised for a distance of 3 centimeters The posterior edges of the divided duct were approximated and the defect anteriorly was covered by a pedunculated flap from the gall bladder with the mucous membrane turned toward the duct lining Hepatic drain removed the tenth day Recovery Six months after excellent health

CASE 3 Reported by Kehr. A defect in the anterior wall of the common duct after the removal of calculi was successfully closed by using the stump of the cystic duct after a cholecystectomy.

CASE 4 Reported by Kehr. Gap in common duct after a cholecystectomy closed by pedunculated flap from the stomach consisting of the peritoneum and the muscle wall. The latter forming the new lining of the duct. Death from pneumonia on seventh day. No leakage. Flap in excellent condition.

CASE 5 Reported by von Stubenrauch. After failure of using biliary fistula tract for anastomosis with duodenum, a new duct was formed by turning upward a duodenopyloric flap of enteric thickness.

CASE 6 Reported by Ginsburg and Spese. Common duct divided in a cholecystectomy (the cystic and hepatic ducts being parallel). Nine days later ends of divided duct exposed and a T tube inserted. The horizontal part of the tube was enveloped in a flap taken from the posterior sheath of the rectus muscle and sutured like a cuff around the ends of the duct and also to the wall of the duodenum, the center of the transplant being perforated for the exit of the tube. After one week biliary fistula reformed and two and one half months later exploration showed tube displaced and impinging on duodenum, fascial transplant applied visible. Small rubber tube placed into duodenum and covered by fascial transplant reinforced by gastrophatic omentum. Three months later a fourth operation as done for patency of ducts and failure of tube to pass. Tuberfulculitis rough duct but could not be reached though in situ in duodenum and was not reached. After a ten day biliary fistula because of possible damage to the duct in course of operation the wound healed and 4 months after final operation the patient is perfectly well.

DUCT RECONSTRUCTION

CASE 1 Reported by Veelhoogen. At primary operation there was found a enormous mass at the junction of the hepatic cystic and common ducts which was cicatrized together with the gall bladder. After the removal of the stone from the lower cholangus the ends of the divided duct were separated by an interval of 6 centimeters. A rubber catheter was passed through into the duodenum and passed upward so as to lie in contact with the end of the hepatic duct. It was here bent at a right angle and brought out of the wound with the tampon. The tube was removed on the twelfth day after operation. The patient as well 11 months after and having had one attack of colic with jaundice two months after the operation.

CASE 2 Reported by Propp. Stricture after a previous cholecystectomy in the center of the gastrophatic omentum resected leaving an interval of 4 centimeters. T tube introduced above and

below and the wound tamponed. Tube removed in three weeks. Biliary fistula completely closed in a few days. Patient did not long remain free from symptoms of recurrence developing jaundice several weeks after the closure of the fistula. Two and one half years later on operation the site of the previous stricture presented a duct normal in appearance with mucous membrane apparently lined with epithelium. The stricture was now situated close to the transverse fissure of the liver in the hepatic duct. This was also treated by the insertion of a T tube. No note of end result.

CASE 3 Reported by Kehr. Hepatic duct divided in cholecystectomy. Collapse of the patient necessitated immediate resumption of the operation without attempt at reconstruction or eduction of stricture. One month after tube was inserted projecting inches into the hepatic duct above and the common duct below. Tampon. The tube was removed four weeks later by traction on silk ligature which had been passed around it. No mention of end result.

CASE 4 Reported by Freeman. Previous cholecystectomy for atrophic gall bladder entirely lacerated in the substance of the liver. Subsequently occurred the duct was indicated by marked jaundice, clay colored stools and by periodical chills and fever. At the final autopsy 18 months after the operation for stricture proved to be due to an ill timed abscess of the liver. At the operation for stricture firm adhesion of the adhesions were encountered and the duct was exposed with difficulty. At the point where the common duct entered the liver and opposite the former site of the gall bladder a cicatricial stricture was found due to the involvement of the duct in the cicatrized liver which had replaced the gall bladder. The stricture was split and along the gutter of the duct a tube was passed up into the upper stricture duct in the liver. The other end left the duct at the lower end of the stricture and was brought out of the abdominal wound with the drain. The tube occupying the divided duct as covered in this situation with peritonium. During the months that the patient survived the duct functioned well. The tools being continually colored with bile. At the autopsy the appearance of the abscess of the liver from which the patient died indicated that it had been in existence for some time before the operation for the stricture of the duct. The duct itself was found patulous although small. It was about the size of a broom straw but fluid could easily be injected through it. There was also found an old duodenal ulcer which had perforated the adjacent liver to which it was adherent.

CASE 5 Reported by McRae. The author cites one case of stricture of the common duct which was treated by incision, dilatation and drainage. The patient was in excellent condition 2 years after the operation.

CASE 6 Reported by Finney. After previous operations by other surgeons a biliary fistula re-

mained. Operation then disclosed a complete obliteration about the center of the choledochus which was excised leaving an interval of an inch. As approximation was impossible a rubber tube was inserted into the hepatic and into the common duct below but could not be brought through into the duodenum. The omentum and adjacent peritoneal structures were carefully sutured about the exposed part of the tube which was accordingly left free in the duct and was never removed or so far as observed passed. The patient is well two years afterward having had one slight attack of jaundice and abdominal pain one year ago.

CASE 7. Reported by Stewart. Previous cholecystostomy by another surgeon. Cholecystectomy by author. Subsequent stricture about one third of an inch in length developed in the common duct just below its junction with the cystic. The stricture was divided and a rubber tube passed from the hepatic above through the common below into the duodenum and was covered by omentum. Death occurred on the fourth day from hemorrhage the source of which could not be determined at the autopsy. The adhesions in this case were extensive and the liver was cirrhotic.

CASE 8. Reported by Voelcker. Defect of from 1.5 to 2 centimeters after a cholecystectomy bridged by tube which was covered in by omentum and liver the tube being left *in situ*. Biliary fistula persisted. Four months later exploration showed an interval of 2 centimeters between the ends of the duct forming a right angle with the tube impacted in the common duct. This was removed and a catheter which had been inserted was passed through into the duodenum and brought out through a Witzel opening emerging from the abdomen with the drain. The tube was removed on the fourth day. Recovery.

CASE 9. Reported by Lyle. Six months after an unsuccessful suture of the divided ends of the common duct in the course of a cholecystectomy operation revealed a stricture between one half and three quarters of an inch in length surrounded by numerous adhesions which was excised. The posterior edges were approximated by suture. As the anterior edges could not be sutured a rubber catheter was passed up into the hepatic duct and down through the common duct into the duodenum. The exposed part of the catheter was covered with the round ligament and omentum. The catheter was passed on the thirteenth day.

The patient remained well for two and one half years and then began to complain of attacks of pain. Lyle states that she was operated on by another surgeon in October 1916 who found a stricture of the common duct with biliary calculi on the proximal side. In January 1917 Lyle examined her and at that time she seemed to be developing a recurrence of the calculi.

CASE 10. Reported by Brewer. Rubber tube between hepatic stump and duodenum enveloped by omentum. Good function. Recurrence in

about a month with jaundice and signs of infection which disappeared but shortly returned the patient succumbing to an operation for its relief.

CASE 11. Reported by Terrier. The author mentions a case of reconstruction of the common duct with omentum which failed and was followed by a successful hepatoduodenostomy.

CASE 12. Reported by Arthur G. Sullivan. Four years ago the author inserted a rubber tube in a man of about 60 who had been operated on at a large clinic for common duct stone. A few months after his first operation he came under my care as an emergency case with symptoms indicating a duodenal perforation. On operation the common duct was found to have been perforated by the pressure of two large calculi. All the tissues were intensely inflamed and the duct had a large rent in it. Drainage. Some time later when evidence of stenosis had appeared an operation revealed so much thick dense fibrous tissue in the duct at the point of former perforation that reconstruction with a rubber tube was necessary. The stricture was at least 1.5 inches in length. His convalescence was rapid and shortly after he again performed the duties of an engineer and has continued in excellent health since the operation.

CASE 13. Reported by Jenckel. Cholecystectomy. Four weeks later increasing jaundice not withstanding the presence of a biliary fistula. Operation five months later showed complete obliteration of the entire choledochus. Tube sewed into the right hepatic duct and passed into the duodenum below through a Witzel opening bridging an interval of 8 centimeters. Tampon. Three weeks later duodenal fistula developed which gradually closed. For a time the patient had occasional attacks of colic and chills which ceased and now 4 years after the operation the patient is completely well.

CASE 14. Reported by Propping. Cholecystectomy (lesion of the gall bladder associated with edema of the gastrohepatic omentum). Five and one half months later stricture was found involving the entire choledochus. Tube extending from hepatic above through Witzel duodenum below bridged interval of 6 centimeters. Death 12 days later from recurrent cholæmic hemorrhage.

CASE 15. Reported by Wilms. Three and one half weeks after excision of the junction of the cystic and hepatic ducts together with the adjacent glands the resulting interval was bridged with a rubber tube passing below into the jejunum being anchored in its course by catgut sutures to the parietal peritoneum. Slight discharge from biliary fistula and light colicky pains in right hypochondrium on sitting.

CASE 16. Reported by Wilms. Cholecystectomy. Recurrence of colic with closure of fistula. At second operation tube was passed from the hepatic above into the duodenum below. Convalescence complicated by duodenal fistula requiring a jejunostomy to secure its closure. Eleven days

catheter discharged through the wound. Thirty eight days after operation tube removed from jejunostomy. Patient well 15 months after operation with slight biliary fistula.

CASE 17. Reported by Wilms. Cholelithiasis found impassable after cholecystectomy. Tube from hepatic duct into duodenum. Functioning of the tube seemed to be proved by the postoperative vomiting of a large amount of bile. Recurrence of biliary fistula. Thirty days after first operation exploration showed tube to be out of the hepaticus. It was then secured in. Ten months after the operation the patient vomited the tube.

CASE 18. Reported by Wilms. Cholecystectomy 6 days later ended in sutures of the ends of the divided duct of a tube. A peritubular fistula formed. Six months later on exploration was found to have been the result of an inguinal of the tube with a separation of the duct ends for a distance of 2 centimeters. The Volker transduodenal operation was then performed. The jaundice persisting a Wilms operation was done after an interval of 7 months. The patient later after the omitting of the tube the symptoms recurred and the operation repeated. In the last operation the tube was passed from the hepatic duct into the stomach. Results. Wilms indicates the ligation of a loop of jejunum in the upper end of the tube to prevent the risk of the tube into the duodenum. The patient died of duodenal perforation. The patient died with the drainage of the abdomen. By treatment on the ileal passage of the tube into the duodenum is supposed to be facilitated.

HEPATOSTOMY CHOLANGIOSTOMY

CASE 1. Reported by Tiegell (mentioned by Scheidte). The author refers to a case of severe cholemia in which Tiegell established a biliary fistula by opening the liver through the gall bladder terminating the operation in a cholecystectomy. The patient recovered from the operation but later died from exhaustion. Scheidte remarks that this might have been prevented had the operation been supplemented by an anastomosis between the gall bladder and intestine and cites this unfavorable outcome as an argument against doing a hepatic enterostomy in two stages.

CASE. Reported by Jenckel. Female age 7. History of attack of jaundice when 6 years old. On admission intense jaundice without colic. On operation the gall bladder was atrophic and empty. There was no dilatation of either hepatic or common duct. Cause of jaundice could not be determined. It was possibly parasitic. To relieve the liver as penetrated with the cautery after being stitched into the incision. Nipple was sutured. The fistula promptly closed and the patient recovered. Shortly after discharge from hospital the jaundice disappeared and the patient

remained free from recurrence being well six years after the operation.

CASE 3. Reported by Cohen. Hepatostomy one week after a cholecystectomy for persistent jaundice the hepatic and common ducts being inaccessible on account of adhesions and fear of hemorrhage. After 48 hours the biliary fistula discharged copiously. After 6 days bile again passed into the intestine and stones were discharged from the biliary (gall bladder) fistula which eventually closed.

CASE 4. Reported by Lohse. Hepatostomy for cancer at the transverse fissure through the gall bladder which contained no bile. On the eleventh day stools again became colored. Death occurred 11 months after operation and several weeks after the complete closure of the fistula.

CASE 5. Reported by Kausch. Hepatostomy for obstruction due to a chronic pancreatitis patient in 6 weeks. During this time a curettage of the liver surface was necessary to secure a flow of bile on several occasions.

CASE 6. Reported by Kausch. Hepatostomy for congenital atresia of the duct the patient dying on the fifth day from peritonitis.

HEPATIC ENTEROSTOMY

CASE 7. Reported by Lambris. Excision of a portion of the common duct. Biliary fistula. Existence of a curvature near the transverse fissure. Six months later leaving only a small part of the hepatic duct above and the common duct below. The jejunum about 40 centimeters below the duodenal jejunum angle was sutured to a defect made by the cautery in the right lobe of the liver. No jaundice. Biliary fistula closed and patient returned to work. Death 8 months later from multiple liver abscesses. At autopsy the mouths of ten openings could be demonstrated in the mucous membrane of the jejunum which were lined with cylindrical epithelium from which bile could be expressed by pressure.

CASE 2. Reported by Scheidte. Female age 8. History of cholera for 11 years. For 8 weeks complete jaundice with a loss of strength and such severe pain as to require constant morphine. On operation the duct was inaccessible owing to tensile adhesions and a marked swelling of the pancreas. The gall bladder was distended with inflammatory exudate but contained no bile. The liver was opened with the cautery though the gall bladder supplemented by cholecystectomy. The Murphy button a loop of jejunum previously closed by enterostomy was being used. The patient recovered and as well as a pregnant 5 months later.

CASE 3. Reported by Kehr. The author reports a case of hepatocolic obstruction to the common duct after excision of a stricture.

CASE 4. Reported by Doherty. In effort to anastomose the duodenum and hepatic duct a

stricture following choledochotomy the liver tore at the transverse fissure and the adjacent duodenum also gave way. The two orifices were then approximated by suture. The patient recovered with a small temporary duodenal fistula.

CASE 5. Reported by Kehr (referred to by Kauh). Hepatoduodenostomy for obstruction in accessible portion of the common duct. Recovery. Jaundice decreased. Patient died 8 weeks later. No autopsy.

CASES 6 and 8. Reported by Kehr. In these three cases a hepato-enterostomy was done for carcinoma of the pancreas. Two died promptly of hæmorrhage. The third died on the seventeenth day and autopsy showed bile in the intestine.

CASE 9. Reported by Czerny. In 1899 hepato-enterostomy for obstruction in inaccessible portion of the duct the patient dying of peritonitis.

CASES 10 and 11. Reported by Kausch. Two cases of hepato-enterostomy for carcinoma of which one died on the fourth day, the bile being collected in a small sac outside of both the liver and intestine. The second patient died on the eighth day from peritonitis. Both cases carcinoma.

CASE 12. Reported by Maylard. Hepato-jejunostomy on liver border for benign stenosis. No improvement after 1 month. Death months after operation. No autopsy.

CASE 13. Reported by Ehrhardt. Hepato-jejunostomy for congenital defect of common duct in child of 6 months. Stools contained bile in 24 hours. Death on sixth day from enteritis. Autopsy showed no peritonitis and sutures holding.

CASE 14. Reported by Lejars. Cholecystectomy. Later drainage of the hepatic duct for stricture. Later on a hepatoduodenostomy on account of obstruction due to general adhesions. Death. No autopsy.

CASE 15. Reported by Garre. Traumatic rupture of the common duct which was drained and subsequently followed by both biliary and faecal fistulae. Six months after accident jaundice developed. Three months later or nine months after the accident a hepatoduodenostomy was done using the left lobe of the liver. Six days after operation the stools contained bile. The patient made a complete recovery and was perfectly well 3 years afterward. (Some believe that in this case the bile subsequently found its way into the intestine through some other channel than by the liver duodenal fistula.)

The preceding cases gathered from the literature and contributed through the kindness of my colleague are of great interest especially in view of the end results achieved. To draw any conclusions of value however regarding the comparative merits of different types of operations and their mortality from cases collected from the literature is most deceptive for a large number of failures to

relieve as well as actual fatalities are never published. For these reasons the statistics of the Mayo Clinic for which I am greatly indebted to Dr W J Mayo and his colleagues are herewith given separately as obviously to regroup the 45 cases with others of their type would detract materially from their interest and value.

REVIEW OF 45 OPERATIONS FOR RECONSTRUCTION OF BILE DUCTS ON ACCOUNT OF BENIGN STRICTURE—STATISTICS OF MAYO CLINIC

Number of cases	38
Female	6
Male	12
Decades	
0 to 10 years	
10 to 20 years	8
20 to 30 years	10
30 to 40 years	13
40 to 50 years	
50 to 60 years	
60 to 70 years	
Cl. of complication	
Colic	8
Jaundice	9
Complete biliary fistula	11
Perforations on biliary system	
Cholecystectomy (elsewhere 13—here 11)	4
Cholecystectomy (elsewhere 3—here 1)	6
Choledochotomy (elsewhere 1—here 4)	5
Cases had no previous operations	18
Present procedure	
Benign stricture of bile duct	4
Site of stricture { Hepatic duct	
{ Common duct	0
{ Junction cystic and hepatic	3
Sermental excision of duct	13
Inflammatory result of stones	
Type of procedure	
1. End-to-end anastomosis or plastic reconstruction of hepatic duct—common duct or hepatic to common	31
Anastomosis of hepatic duct to duodenum (hepatoduodenostomy)	12
3. Anastomosis of hepatic duct to stomach (hepatogastric anastomosis)	
Type of catheter	
With a tube (Sullivan or T)	8
No tube	1
Hospital mortality	11.1

RESULTS

Number of cases	
Cases learned from	23
Cases died after operation	3
Cases still living	9
Attacks of colic: correct	0
No colic	14
Jaundice after operation	11
No jaundice	12
No bile drained from wound after operation	3
Bile continued to flow continuously	19
Healed without fistula	4
Wound healed after operation	19

- Sight to der
No h ma b l g n g of the wo r d o y ca 4
C s i i g f id 2
Continu s d p j a u d c e n d y g f e montl 2
De p j u n d e b y t t a c k 3
Only slight ja n d c e c a s n l l y 6
Of l i n g q e s b l y l l a n d b l t o k
O e l m e t c o m p l t e l y u n c a p t t d u c u t o f a t t k
f l c a n d j a n d e
O c a s e q t e l l — r e n t l y s a i d d f P t r t r a l
T o c a s h b r c h i l d r n i e
Of t l l l t d d
O n c s r p t e d t o h a v d i d o f a m f t h e
p n
O n e d i n t d l l a n d d o f m e s i t i t o
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R E S T O D I F L R F T E T N f
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B R E V E T A m S g A s s 9 l o i d l 1
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C O H E M n h n m d W e h n s c h r 9 i 54
C R I L L I r n l e m t
D A I Z t l b l f C h 99 p 66
D A I P O R T G E O L l l c m t o
D E L A T O U R l o n l m m t n
D O B R A U E R B t r k l n C h r l x 4
D L K E R i n l n W h h 19 o 44
D U J A R I E R d B z a B l l e t m m d C l \ f
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E N R U R D Z e t l b l f C h r 97 p
L L T \ P s l c m m t n
L N D L R E V M n c h n m d W l c h 9 l c f
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H I R S C H B E R G B l l h W e h s c h r 9 u i
H T C H N I S S P n a l o m m n c t i
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J A C B S v A m J O b t N l l e x 948
J I S O V P e r s o a l c m m n c a t i
J A C S O i S g G y n & O b t 914 x x 33 a n d
p r o n a l c o m m n i t n
K A S C H A c h f C h r x c i 83
K E U R Z t l b l f C h 900 5
K E U R l d G l l a g e W t u d B l d 913
K E U R Q t d b y K a s c h
K E U R B t r k l n C h r i 59
K H R A r h f c h 89
K E U R C g l d M e d x x i 5
K i i l f C h r c i 599
J M / a t b l f C h r 9 p 60
I H A R S m m d t o 1 37
L f / t r l l f C h r 9 p 69
I H H l n l m m n t
K r i / t l b l f C h r o 4 p 5
M A t i P l m m n a t
M A s l (y & O b t o 4 i 36 a d
3 i n l m m t n
4 M A W J P s o l m m u i t o
M P E f s o i m m u t o
M C \ \ l n l m m u n a t
M k t i A Z t l b f C h 333 941
M A L R D \ S u l h l 9 p 57
M A R l f m a d 2 \ 4 37 t 3
M r p t r Z t a l b l f C h 99 p 33
M r u F T i l m m t
O f v l r s a a l c m m c t n
l P e a l c m m t
P c s e t s t l
P R i n B i t z k l n C h 369
O t l l f r l d C h r o
I T E R A r l f C h 86 c
S c h l R B t k l n C h o
S L V M P s o l m m i t l l f A m M
A 900 M a r h
S L J C h A s g f h l 9 J u y
S W I M u c l m d W h l o p 34
S T I T \ \ l M d K d o l v 61
T E R P l m t n
T R E R d C t C g d l 908 p 85
T D A Z t r l b l f C h 900 t 3
V i s u \ R A h C h r C t 96 l u 39
V r i o Z n t l l f C l q s p 90
V f k B t z k l n C h 59
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DEPARTMENT OF TECHNIQUE

REPAIR OF TENDONS IN THE FINGERS AND DESCRIPTION OF TWO NEW INSTRUMENTS

By STEPLING BUNNELL M D SAN FRANCISCO

DISABILITIES from injured tendons in the fingers are common and especially important from the standpoint of accident compensation. Successful return of function through surgery is very rare. Why do our repairs of old injuries of finger tendons using surgery as we find it almost invariably result in adhesions and considerable loss of function?

The hand is a wonderful piece of mechanism with its strength of tissues its many delicate parts its smoothly gliding tendons and its pulleys and joints all working with such nicety that there is little in the refinement of motion that the hand cannot do. The surgeon who expects to attain success in the repair of tendons in the fingers must so regard it.

My first attempts at repair of tendons in the fingers resulted in immediate successes but as the succeeding days went by the motion became less and less until at the end of a few weeks it became nil. The tendons had become firmly imbedded in scar tissue and had united to the surrounding finger in a solid mass. Such failures as these prompted me to work out a method of treatment which would yield better functional results in these cases.

In the parts of the body where large fatty sheaths can be grafted about tendons good results are easy to obtain but within a finger there is not sufficient space for thick fatty grafts. Then too in a finger the tendon changes its direction at each of the three joints so that another difficulty met with in a finger is the problem of maintaining a smooth frictionless pulley at each joint.

In many parts of the body a tendon may move sufficiently for normal function through fat and without a tendon sheath. This is the normal arrangement wherever a tendon does not have the friction of pulling around a corner. It does not slide through the fat but is adherent to it and merely drags the fibers of the loose fatty elastic tissue (paratenon) first in one direction

and then in the other. Let us call this the paratenon formation. Thus the central part of the fat which is adherent to the tendon moves with the tendon while the peripheral part of the fat which is attached to the surrounding fascia does not move. Therefore the fat must be either very loose in structure or if denser it must be thicker. This looseness is difficult to maintain in fat when grafted with the usual amount of surgical traumatism for in the wake of the surgeon is dense scar tissue. Therefore if a free fat graft is used to keep our tendon mobile it must be of maximum thickness and under minimum traumatism.

There is another feature about fatty grafts that must be regarded and that is that the quality of fat differs in different parts of the body.

Thus the subcutaneous fat which is the one usually used is of the poorest quality for use in surrounding tendons. It is short fibered non elastic and soon turns to a white fibrous tissue scar. The best fat for the purpose is that gathered from the neighborhood of tendons such as the triceps or achilles. This specialized fat is loose and of long elastic fibers and seems to slide and give in an elastic way as we pull it back and forth. Such sheaths as fascia blood vessels silver foil or cargile membrane when used in the fingers surely lead to adhesions.

The following is the tendon sheath formation. Wherever a tendon pulls around a corner it is enclosed in a tendon sheath. All finger tendons are in these two layered sheaths. The inner layer (epitenon) embraces the tendon and is continuous with the two layered metenon (which bears the blood vessels to the tendon) and this long mobile mesentery like sheath is in turn continuous with the outer layer of the tendon sheath. The outer layer is adherent to the surrounding fascia. At the ends of the sheath where its two layers meet a pull of the tendon causes invaginating wrinkles called plicae to form in the tendon sheath and a pull

in the opposite direction will open them out. The mesotenon is on the side opposite the side of friction. In the finger there is no mesotenon distal to the distal end of the metacarpal (i.e. within the limit of the tendon sheath) except for the three small bands pictured in anatomies known as ligamentum breve and ligamentum longum. Of the former there are two attaching the profundus to the distal ends of the proximal and middle phalange. The latter stretches to the flexor sublimis. In the palm there is no mesotenon except in the distal half so that when the fingers are flexed there is no mesotenon attached to the parts of the flexor tendon which are then over the wrist.

The tendon sheath formation is indeed a delicate complicated structure for a surgeon to reproduce. The paratenon formation for the finger is more possible for the surgeon to imitate but in fingers where the tendon pulls around three corners we need the tendon sheath if we are to attain full function. Our best method to attain this is to graft a tendon with its sheath and all ready made from some place from which it can be spared. Such a graft may be obtained from any of the branches of the extensor communis digitorum in the foot and to replace the function of extension in the robbed toe the adjoining tendon can be split and made to do double duty. The feet on which I have performed this operation have not been in any way injured but have retained perfect function of the toe. Through a curved incision to one side the tendon with its sheath and strip of superficial fascia overlying can be lifted from its bed and held intact by catching the fascia around it in several places along its length with safety pin or towel clips. It can then be excised intact care being used to cut the sheath longer at each end than the tendon. A few fine sutures may now be taken to unite the edges of the strip of superficial fascia into a tube formation about the tendon with its sheath. This elongated structure can now be drawn through the pulleys into its new bed and its tendon ends can be attached.

If the paratenon formation is to be made the graft can be taken from the tendon of the triceps excising a strip of tendon keeping its overlying paratenon tissue intact and suturing the fat of this paratenon tube like about this tube of tendon. In a similar way the achilles tendon or fascia lata or the dorsal half of the extensor longus hallucis may be used. The tendon of the palmaris longus can easily be dissected out with its paratenonous tissue intact and sutured to a very good graft. The paratenon formation on graft

in the fingers will give function but not as complete function as can be obtained by the graft of tendon in its tendon sheath.

The causes of failure in repairing tendons in the fingers have been the following: (1) traumatizing technique (2) median incision (3) obliteration of pulleys (4) using methods which replace the gliding mechanism by adhesions (5) too much or too little postoperative movement (6) crude suturing of tendons.

These will be discussed in order.

Not only is it necessary to maintain a perfect aseptic technique in tendon work but also an *atraumatic technique*. If this is not done our structures will become hopelessly imbedded in scar tissue. To obviate this the utmost delicacy should be used in handling the tendon and sheath and surrounding tissue. The *endothelial* covering of the tendon and lining of the sheath is easily marred by grasping with forceps or by rough handling. A tourniquet or blood pressure band should always be used to avoid the trauma of palpation. Trauma in the surrounding tissues increases the inflammatory reaction about the tendon and results in adhesion just as a fracture of a phalanx often causes the flexor tendon to become adherent to its sheath in the neighborhood of the fracture. We should therefore reduce our movements in handling to a minimum by making each movement purposeful and efficient. Tremor makes trauma and should be eliminated by bracing the hands. Retractors should not pull to the degree of tissue strain and should be kept immobile by bracing. The sensitiveness of the tissues to trauma should ever be kept in mind but with our attention directed to delicacy toward the tissues we must not prolong their time of exposure as this too causes inflammatory reaction.

The next cause of failure is the *median longitudinal incision* on the volar surface of the finger. This is the most common incision made into tendon sheaths in fingers for repair of tendons or for the drainage of pus from the tendon sheath and it leads to several bad features. It often causes a progressive contracture so that the finger becomes permanently flexed clear out of use. It also places a scar just in the pulley surface of the tendon sheath that becomes adherent to the tendon and binds it to the part. A transverse incision is a better one but best of all is a lateral longitudinal one between the two lateral arteries that preserves intact the friction volar surface of the tendon sheath. If on the index finger make the incision on the ulnar side where it is less subjected to friction. A combina-

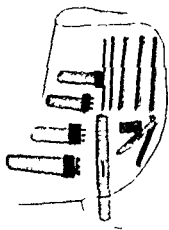


Fig 1

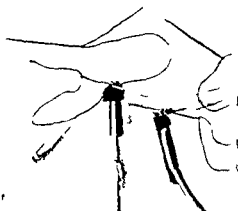


Fig 2

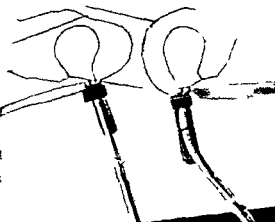


Fig 3

Fig 1 Tendon clamps with rod for shaping them
 Fig 2 Suture end of tendons using tendon clamp
 To right first needle is starting to left second needle is starting and first needle has finished

Fig 3 To right second needle is entering proximal slit and emerging through distal slit. First needle has finished. To left second needle is making the last stitch and first needle has finished

tion of the transverse and lateral incisions as an L shaped incision is useful especially over the insertion of the profundus. The position of the lateral arteries and nerves is one pair on a level with the volar surface of the flexor tendon and the other on a level with the dorsal surface of the extensor tendon.

Another cause of failure is the *obliteration of the pulleys* in the fingers. Opposite each of the three joints is a strong pulley lined by the tendon sheath. If the pulleys are cut and not repaired the tendon will span across the joint angles like the string on a bow and necessitate the wearing of a broad ring as an artificial pulley. Instead of cutting the pulleys it is best to preserve them by skipping them in making the lateral incisions and to pull the tendons through them. If the

pulley is gone a new one can be reconstructed by a tendon graft.

The main cause of failure is in adopting methods which replace the *gliding mechanism* by adhesions. A fairly smooth unbroken adherent tendon when carefully freed of its adhesions and given a week of rest on a splint for repair of the wound and then put through voluntary motion will form its own synovial sheath and give a fairly good functional result. If on freeing the adhesions a very rough raw surface is left then a free graft of specialized fat as mentioned above placed sleeve like about the tendon will also give a fair result though usually not complete in function. Where a graft is used sufficient time of splinting should be given before starting movements to allow the graft to acquire a blood

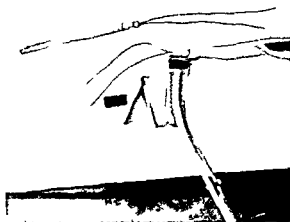
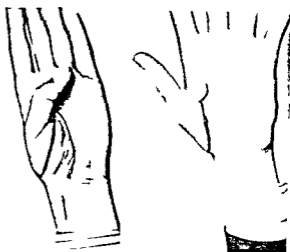
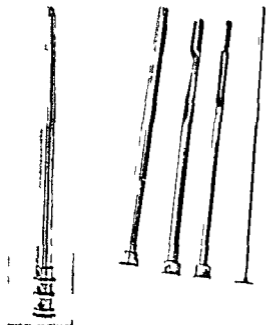


Fig 4 Sutures placed. Clamp removed from left tendon



Fig 5 Sutures have been tied attaching the tendon end to the other



supply and sufficient vitality to tend the friction. When a tendon that is imbedded in adhesions is freed the surface of the tendon is usually very ragged and hacked. To avoid this it is well to use the tendon tripper to liberate it further on.

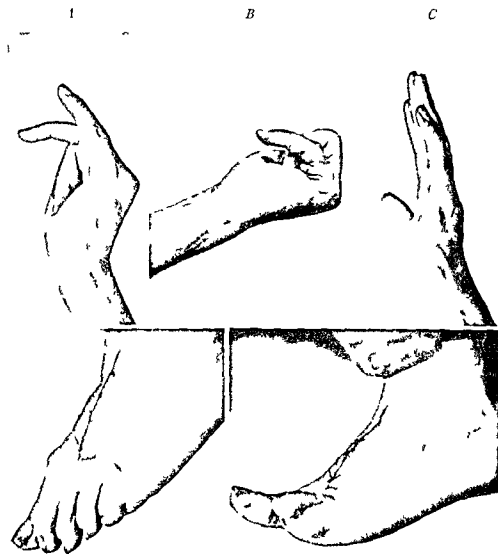
Tendon suturing may be done in two ways: the first operation being to unite the tendon and plant some fatty tissue about it and the second operation six weeks later to free the tendon and establish motion. Partial function will be obtained.

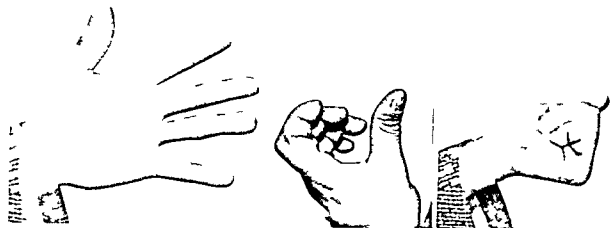
Suturing of freely exposed tendon will give a far better result than repairing such cases when old. In the case of the grip between the tendon ends is filled in with dense scar tissue that must all be dissected out and the sheath destroyed for over an inch. In such cases it is better to cut out the whole injured segment and insert a graft of tendon with its sheath. It is usually best to draw the whole tendon from its

the C. E. M. B. t. d. m. s. l. f. th. mb. f. d. g. m. t. n.



the C. E. M. B. t. d. m. s. l. f. th. mb. f. d. g. m. t. n.





A
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B C
 I h t h h l g f l t a v t d
 fl f th d t l t ph l g l j t
 B S m s e h g good l t v l h
 l t l t r l k l j t ft th l (th fl
 t l th f t th i g
 C S m c h k m l t f fl b
 t l th f d f g

sheath from it in ertion to the palm and to replace it with a new tendon thus making the tendon suturing at the insertion and in the palm where adhesions are likely detrimental. An autograft provokes inflammation reaction and resulting adhesion than does a brittle foreign body such as a strand of silk thread. The latter method used in the finger even with capsule membrane about the silk leads surely to adhesions. Tendons should be kept away from superficial tissue and suture line.

Movement should be instituted with care and judgment. In the first week it will prevent the incision from healing and encourage infection. If begun late adhesion will already have immobilized the tendon. Rough extreme and continuous movement will cause fibrin and cartilage to form and bind the tendon and also will cause the sutures to cut out. Rest favors a natural repair with a minimum of inflammatory reaction but also allows adhesion to form to all raw surfaces. Movement encourages the formation of synovial membrane over the raw surface. It would seem that a moderate amount of intermittent movement with as long an excursion as practical interspersed by rest will yield the best result.

The *tension* at which a tendon should be attached has been worked out by Mayr. The length of the tendon should be so arranged that when the origin and insertion of the muscles are approximated as nearly as physiologically

possible the tension of the tendon will then be zero.

Isoperis must be as near absolute as possible. The degree of a *epi* that is satisfactory for all dominal work does not leave a sufficient margin of safety if indulged in while repairing tendons and especially where graft are used.

There are many fingers severely damaged by infection that it would be folly to attempt to repair the tendons. The lenient cold stiff finger with smooth bluish red skin that are left after the storm of infection has passed are poor material for constructive surgery. If only a part of the finger of this type it is better to excise the area of scirrhotic skin and transplant in its place a pedicled flap of good fat lined skin. Operation on a severed tendon should not be done sooner than a month after the primary wound has healed as follows in operation the newly formed car in the kin is liable to undergo necrosis.

The last cause of failure mentioned is *crude suturing* of tendon. After suturing the extremity of tendon sutured should be of equal or slightly smaller diameter than the rest of the tendon. It should be smooth unfrayed and covered by it undamaged and not covered. If a rugged rough joint is left from the plastic work on a tendon it is far better to cut out the whole segment and bridge with a good graft. The suturing can then often be done in the palm where adhesions are more easily prevented. The old tendon may be withdrawn. If the sheath is

intact the tendon alone may be transplanted but if the sheath is too damaged it is best to transplant a tendon with its sheath. To obtain more room in the finger the sublimis may be with drawn and sacrificed as the loss of its function is hardly noticed. This segment of sublimis can even be used to transplant or graft as a substitute for the profundus in the same or in a different finger.

Many methods of placing the stitch have been described but the only one that appeals to me as being efficient is one in which the thread is spliced into the tendon thus getting its grip over a length of tendon binding the fibrils together and having its knot buried in a slit or between the two ends of the tendon. Two sufficiently heavy strands are better than many light ones as they are less apt to break or cut out. Silk or linen is preferred and the suturing should be strong enough to stand the strain of voluntary motion of the tendon until the physiological tendon union has taken place. This takes six weeks.

CLAMP FOR TENDON SUTURE

The following is a device I have made by which the above essentials may be carried out in the end to end joining of a tendon.

The object of the tendon clamp is to unite the tendon ends so that there shall be a smooth surface covered by its original undamaged synovial membrane that the diameter of the joint shall be uniform and a little smaller than that of the tendon proper that there shall be no fraying of the tendon ends and that all fibrils will be bound together in one endothelial covered tendon that the actual union shall be exact and with no separation that a splicing and not a strangling suture may be used that no knots will be present on the surface and that trauma to the tendon shall be reduced to a minimum. These requirements cannot be obtained when the tendon is sewed handling it with as crude an instrument as a tissue forceps.

The clamps as shown in the picture are made in graded sizes and of thin flexible spring steel (S S White matrix steel gauge 003 or matrix strips made of German silver gauge 003 obtained at dental supply houses). Separating the arms of the clamp the tendon is gently laid in the cylindrical end and held there firmly by sliding the sleeve down the arms of the clamp to the tendon. A hammer is then placed on the clamp arms against the sleeve and serves to keep the sleeve up snug and as a handle for the tendon. The end of the tendon is then trimmed off flush with the end of the clamp with sharp scissors.

Each end of an eight inch piece of linen or silk is threaded on a self threading cambric needle. One needle is then thrust through the tendon starting at one side at the proximal edge of the clamp passing diagonally downward through the tendon and emerging at its opposite side through the proximal slit in the clamp. Bringing the needle around this slit to the original side it is again thrust through the tendon passing into the proximal slit and emerging from the opposite side through the distal slit. Again the needle is brought around to the original side of the tendon and thrust through the distal slit and made to emerge from the end of the tendon just to the other side of the center of the tendon. The needle on the other end of the suture is then passed through the tendon in a similar manner but starting on the side of the tendon opposite to that which the first needle entered. The two suture ends will then be emerging from the end of the tendon near but on the opposite sides of its center. The clamp is then removed and a fairly strong pull is made on the sutures so that all the slack that is going to come is pulled out at this stage.

The other tendon end is sutured in the same way so that two strands emerge from its end also. The origin and insertion of the muscle are then approximated to eliminate tension in approximating the tendon end to each other and the sutures are tied each to the one that is opposite and cut short. The result is a machine sewed joint with buried knots and with nicely approximated ends. It will not separate when tension is applied and it will fulfill all of the requirements mentioned above.

TENDON STRIPPERS

It is very difficult to free a tendon from its tunnel through the finger or the wrist when it is densely imbedded in post infection adhesions and scar tissue. The usual result is a very ragged or broken tendon with a surface so rough that it cannot heal and will immediately form new adhesions. For freeing such tendons I have made the tendon stripper shown in the illustration that will follow intimately along a tendon and plane the adhesions away from its surface. A nest of cork borers can readily be filed sharp ended and smoothed into the tendon strippers. The cylindrical end is slipped over a tendon by virtue of the slit. As the tendon is pulled taut and straight the stripper is gently shoved along it with a whirling motion. The long cylindrical shape of the instrument guides its sharp cutting edge so that it accurately follows the surface of

THE FATE OF THE CYSTIC DUCT AFTER CHOLECYSTECTOMY

AN EXPERIMENTAL STUDY

BY DANIEL N. HINDRATH, A.B. M.D. and H. C. DUNLAP, M.D. CHICAGO

When first becoming interested in the question of the fate of the cystic duct after removal of the gall bladder through the following clinical case:

This patient, a man, 50 years of age, had been ill for several years with recurrent attacks of pain in the right upper abdomen. He had been seen by several physicians, and the diagnosis was gall bladder disease. He had been treated with various remedies, but without success. He had been in the hospital several times, and the diagnosis was confirmed by roentgen examination. He had been operated on several times, but the pain continued. He was finally brought to the hospital of the University of Chicago, where he was operated on by Dr. H. C. Dunlap. The operation was a cholecystectomy. The gall bladder was found to be enlarged and filled with stones. The cystic duct was found to be dilated and contained a small portion of the gall bladder. The common duct was found to be normal. The patient recovered well from the operation and has remained well since.

The only similar case observed clinically which has been published up to the present time is that of Fliercken

A cholecystectomy had been performed twelve years previously by another surgeon with second operation as performed on account of the recurrence of severe colicky pain. A cystic structure the size of a plum (3.5 cm. long by 1.5 cm. wide) was found communicating with the common duct by a narrow pediculous pedicle. Upon dividing the latter, the bile escaped from the common duct, showing that it had been a direct communication between the periductal bladder and the main bile duct. In the wall of this neformed gall bladder was a brown soft calculus.

In looking over the literature of the subject we found that experimental work had been done by Oddi, DeVooght¹ and Haberer and Clairmont. Oddi in addition to observing in four animals the dilated condition of the bile ducts after cholecystectomy found that the cystic duct became enlarged so as to form a small gall bladder. Haberer and Clairmont confirmed the work of Oddi in a series of experiments on dogs and cats. In ten animals the gall bladder was removed at its junction with the cystic duct. In two other animals the entire cystic duct was removed with the gall bladder and in one experiment a small portion (one half centimeter) of the cystic duct was left. The animals were killed at intervals varying from two weeks to six months and in all of those in whom the cystic duct had been left this structure dilated to form a gall bladder. This did not occur when the cystic duct had been removed close to the common duct.

We desire to report a series of experiments undertaken to study the problem of what

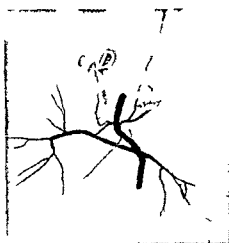


Fig. 1

Fig. 1 Cystic duct (CyD) one week after removal of gall bladder of dog at its junction with the cystic duct. Compare the beginning dilatation with those of later periods (Figs. 2 to 6).

Fig. 2 Appearance of cystic duct (CyD) two weeks after the removal of a dog's gall bladder. Note the

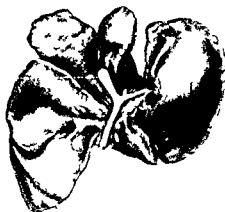


Fig. 2

formation of a new gall bladder in the stump of the cystic duct.

Fig. 3 Appearance of dilated cystic duct (CyD) two weeks after cholecystectomy in dog. Compare this specimen (roentgenogram taken after ducts were filled with bismuth vaselin) with Fig. 2.



Fig. 3

becomes of the cystic duct in a manner similar to those reported by von Haberer and Clurmont in 1904.

Technique Through an upper right rectus incision the gall bladder was carefully separated from its liver bed and ligated with silk at the junction of the cystic duct and gall bladder. No attempt was made to remove any of the cystic duct. The animals were killed at intervals varying from a week to four weeks, then every two weeks for the second month and finally every month up to six months.

Results of experiments At the end of the first week the cystic duct had dilated so that it was about twice the size (Fig. 1) of the same structure in a normal control animal. The duct grows rapidly in size from the second to sixth week (Figs. 2 to 6 inclusive) until at the latter period a structure is found 4 cm long by 1.5 cm wide which greatly resembles a normal gall bladder in appearance. It has a relatively wide fundus and a narrow neck. After killing the animals at the intervals stated the bile passages were filled without pressure with a 10 per cent solution of bismuth in vaselin while

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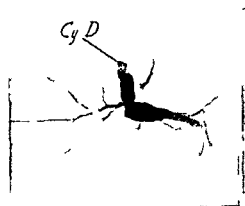


Fig. 4

Fig. 4 Appearance of dilated cystic duct (CyD) four weeks after cholecystectomy in dog. Note gradual increase in size from first to the fourth week.



Fig. 5

cholecystectomy in Fig. 5 note pear-shaped pseudo gall bladder with narrow neck.

Fig. 6 Appearance of cystic duct (CyD) six weeks after cholecystectomy in dog.

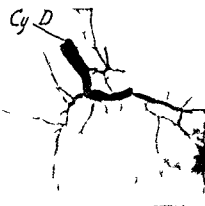


Fig. 6

the latter was in a liquid state and then a roentgenogram made to obtain the actual size of the dilatation. In order to anticipate the criticism that the cystic duct stump had been artificially dilated beyond its actual capacity we injected the cystic duct of control animals the gall bladders of which had also been removed and we found that there was a striking difference between the normal duct of our control and those of our cholecystectomized animals.

Clinical application of experiments. Hoerckens case our own and a similar one in

the service of Dr. L. A. Grunfelder of our hospital show that we can have recurrence symptoms through dilatation of the cystic duct to form a new gall bladder with or without formation of calculi in the same. We believe that more care must be exercised in the future to remove the entire cystic duct as close as possible to the common duct. Our experimental work confirms that of Haberer and Clairmont in every particular.

We wish to thank Miss Gertrude Stern for much valuable assistance.

REMOVAL OF PORTION OF STERNUM FOR LIGATION OF THE INNOMINATE ARTERY

WITH REPORT OF TWO CASES

B. W. T. COUCHMAN, M.D., F.A.C.S. ILLINOIS

THE operation of ligation of the innominate artery is as far as apparently not a popular one. Thompson (1) of London was able to collect twenty cases operated on since 1850 and of these only twelve recovered. In twelve the innominate alone was tied with five recoveries; in twelve the innominate and common carotid with seven recoveries; while in two the innominate, carotid and vertebral were tied with no recovery. In the face of such data there seem to be reasons for the unpopularity of the operation.

To enter into a discussion of the best method of dealing with aneurism of the upper part of the right subclavian or carotid is not the present intention of the writer. I presume that none will gainsay the statement that a case may present itself in which it seems best to ligate the innominate artery or at any rate to occlude it temporarily totally or partially. One can conceive of an aneurism in the root of the neck, or close in toward the inner end of the clavicle as to convey the impression that the first part of the subclavian or beginning of the carotid is involved and at the same time the swelling may so fill the site and base of the neck as to render diligation not difficult of attainment and most uncertain of result.

One may decide to extirpate an aneurism in either of the above named sites in which case

temporary arrest of the stream through the innominate would perhaps illustrate the matter. Again in the bilateral operation of Mata (2) we have the counsel of the martyr himself who alive temporarily occluded until one is certain that the collateral circulation is good. And that there have been and will continue to be cases of bleeding where ligation of the innominate is the only or the last resort of the surgeon need I undure an argument.

Ordinarily when we wish to tie the left he approaches it by the most direct route cut down on it as the pre-implant and with the least trauma and the least dissection possible applies his ligature and closes the wound. Even thirty years ago we now learn that trauma favors infection and infection almost the only cause of secondary hemorrhage. Why then in the case of the innominate—the operation where secondary hemorrhage has been the cause of death both before and since the day of Lister in more than 75 per cent of the mortality list—do we not act as we do when tying other arteries?

The incision of Mott (3) has been that most often used. When the aneurism is small and when the neck is long and thin and the division of the innominate high the operation is difficult. I have never had occasion to attempt it on the living but I have done it more than once on the

cadaver and when I imagine what it must have been in the presence of an aneurism with the engorged veins the struggling patient and the lack of direct light I tremble with fear and am speechless with awe and admiration at the courage and skill of Valentine Mott. And if difficult under favorable conditions what might it be in the presence of a short innominate, a short fat neck, or a large aneurism encroaching against the sternal end of the clavicle and upper end of sternum?

Graefe (4) in 18 made one incision only downward along the inner border of the sternomastoid. Cooper (5) of San Francisco in 1859 resected the inner two inches of the clavicle having found an *aneurism on the carotid and another on the subclavian*. Moynihan (6) turned up the inner end of the clavicle and the adjacent corner of the sternum. The operation of Graefe who failed to divide the muscles (sternomastoid, sternothyroid and sternohyoid) rendered the work of the operator and assistant more difficult than any other but made for less dead space so the author believed. The removal of the inner end of the clavicle certainly gives more room and ordinarily is not difficult. However if the aneurism be large it must not be forgotten that the bone itself may form part of the wall of the sac just as the vertebræ, ribs or sternum often do in aneurism of the aorta. I know of one such case in our own city in which while the clavicle was being removed in an attempt to excise the aneurism the sac wall was opened and the patient bled to death. Again after having removed the clavicle one may find a low division and then be obliged to remove the upper part of the sternum. The cavity left after having removed a small portion is harder to obliterate than that left when a large portion is removed.

Spencer (7) in 1889 experimenting on monkey used a vertical median incision with a transverse incision at the lower end through the skin only. Twyman (8) used the method in 1890. Percy Sargent (9) in 1911 used the median incision and removed the right half of the manubrium with forceps and Herzen (10) in 1910 used the incision of Spencer and removed the inner third of the clavicle and in addition removed the upper end of the sternum with Luer forceps.

Several have used the median incision and have split the manubrium, the so called incision of Birdenheuer. A great deal of traction is required to separate the edges of the split manubrium. To maintain the piece at three fourths of an inch for the necessary time would probably overtax the strength of even the best assistants. Sheen



FIG. 1. Author's incision.

(11) advises the procedure and suggests an automatic screw retractor. Such an instrument might serve the purpose if it were at hand.

What objection can be raised against the removal of the upper part of the sternum? I mean its total removal say from just above the third cartilage upward. The sternum acts as a fulcrum for the clavicle when the shoulder is moved. Yet the whole clavicle is often removed and I have seen such a case and know that before six months have elapsed the patient can use the corresponding limb as well as ever. Some human beings are born without clavicles and others with very rudimentary ones. This being so it seemed to me that the loss of the sternal support of the clavicle is not an objection to the operation. And in Case 1 herewith reported the patient after three months was able to use the left upper limb as well as ever (the right still is paralyzed) and the sternal ends of the clavicles are held firmly to the first ribs by their original rhomboid ligaments and to each other by scar tissue. Another objection is that there is increased danger of injury to the lungs or pleura. This seems to me not to be true in fact I quite believe that the danger of injuring the pleura or other important structures is far greater when other methods are used. Furthermore if one should injure an important structure how much easier to repair the damage when one has free access and good light. Again it may be said that it weakens the chest and leaves important viscera exposed to trauma. This seems to be the best and only real objection and this can be overcome by leaving the anterior periosteum as I did in my second case. However in Case 1 the hollow now existing is not more than the width of my index finger. The question of shock may arise as an objection in the minds of some. I can only say that there was no very serious shock.

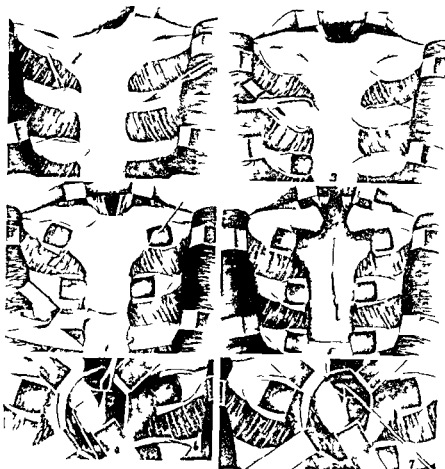


Fig. 1. S. t. p. p. t.

in either of the cases her reported. The additional time required may be another objection by the older method. I see that it has some times taken from two hours to two hours and a half. By this method with good assistance I feel the additional time if additional time be required is not an objection of any weight.

The chief reason for recommending the sternum as low as the upper border of the third cartilage are first that it gives an abundance of room and allows one to work without danger of injuring important structures and that the partial occlusion or temporary occlusion may be done and the permanent line at a later date without encountering greater difficulty or risk at the second operation. Secondly in advantage to cut straight to the artery without flung dissection since this procedure favors low healing and suppuration. The important structures except the left innominate vein do not come into the field at all and this vein can be readily pulled down when one has room. Finally in closing the wound one

can easily obliterate all dead space in the chest by sewing the incision in the soft tissue in front of the artery thus still further lessening the chances for infection.

The skin wound does not close well without under cutting but if this be done for say two and a half or three inches from the cartilage end the flaps fall easily into the place formerly occupied by the bone and light pressure prevents the accumulation of the fluid under them.

The following two case reports will illustrate the method advocated. The illustrations here with shown refer to the method used in Case 1. In Case 2 the method varied a little. The incision was a median one and the anterior periosteum was reflected with the overlying tissues. There was hardly any bleeding. There was room but not quite as much as in the first case. It would have been better to have removed more of the cartilage but they were cut so close as possible to the edge of the sternum. The internal mammary arteries were not even seen.

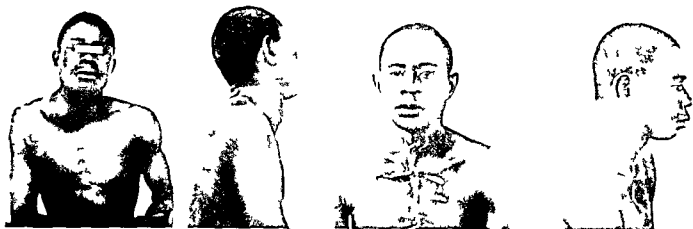
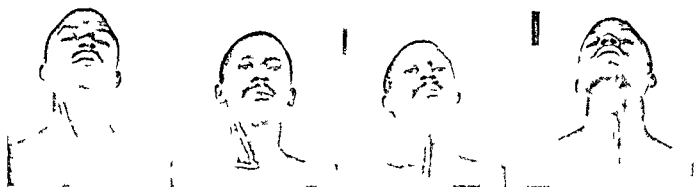


Fig 8 Case 1 Before and after operation



Fig 9 Case 2 Before operation and during, showing incision used



Craef's incision

Mott's incision

Spencer's incision

Sargent's incision

FIG 10

Should I ever be called upon to operate in a similar case I should use the same method as used in Case 1 but would remove the inner one half to three fourths of an inch of each cartilage. I believe the conservation of the anterior perosteum of the sternum will perhaps lead to the reformation of a bony support between the ribs and so do away with what I regard as the most powerful argument against the removal of the ster-

num in ligation of the innominate although in my opinion the argument is not of any great moment.

CASE 1 City Hospital No. 50 1916 C. B. negro 11 yr. of age admitted May 9, 1916. The patient was suffering from aneurysm of the right subclavian artery and it was decided to occlude the innominate temporarily and later to ligate the same.

First operation May 18 1916. After intratracheal method Anesthetized with median line from the 1st of the upper margin of the clavicle down and four

A most striking difference between the two was in the amount of blood lost while reflecting the flap and exposing the artery hardly any bleeding taking place in Case 2. This was due to the use of adrenalin in the no. 30 cocaine solution and to the fact that the flap included the periosteum of the anterior face of the sternum. Also in Case 2 the flap were not dissected up from the rib far out as in Case 1 therefore none of the anterior perforating arteries nor branches of the external or of anterior intercostal were cut.

Access was hardly so good as in Case 1. However it is not to this that I attribute my lack of success in Case 2 but to the fact that the artery was very friable (luetic arteritis) and was so firmly fixed in its sheath that I probably weakened the vessel walls in my attempt to separate them. Furthermore the band was not as blunt and smooth as it ought to have been and it is possible the space cleared posteriorly was not as wide as it should have been and in addition I did not lift the artery while passing the band or interpose a director as I should have done.

SIMPLIFIED SKIN GRAFTING

By J OGER DURHAM MD FACS BROOKLYN

A t t S g M t l f t E l p l H p t l

THE history of skin grafting or transplantation is not of recent date for fragmentary glimpses of a rudimentary knowledge of the art may be traced back many centuries to times of crudest surgery. Leonard Freeman (1) in his very complete book on the subject presents many very interesting bits of history. He relates that skin grafting as well as many difficult operations were performed successfully by the Hindus two thousand years ago notably to replace noses which had been removed for punishment for certain offenses. Strange to say this was done by a low cast of laborer the tile makers. This art was lost sight of during the Middle Ages except for some few more or less authenticated cases here and there as a report by Sancassani (17,1 to 1,38) of a woman skin to the modern detail man who to prove the efficacy of her salt cut pieces of skin from her own leg and replaced them at once with a dressing of her wonderful ointment. The resulting union was said to be almost indiscernible. Tighiucenza a Bologna surgeon at the end of the eighteenth century constructed a nose for a patient in Brussels from the skin of a workman's arm. The skin from the back of a student's hand is said to have been used in the formation of a woman's nose by Dzondi. As early as 1836 Hoffecker a surgeon to a student's dueling corps in Heidelberg succeeded in reuniting severed portions of the nose pieces of lip etc. The earlier reports were of course incomplete and made to favor more of the miracle than of scientific knowledge.

On December 8, 1869, Reverdin (2) presented his historic report to the *Société Impériale* revealing the possibility of the successful application of small multiple grafts to granulating surfaces. And David Lige, president of the Royal Medical Society of Edinburgh, with the lack of length of vision that has marked many a great physician, said skin grafting was not likely to occupy a permanent place in minor surgery.

Le Fort (3) in 1892 transplanted a whole thickness flap from the arm of a patient for the relief of ectropion. Wolfe or Krause grafts consisting of the entire skin layer freed from the underlying fat soon became well known.

Thiersch (4) in 1856 and later Ollier developed the method of using large grafts of part of the skin thickness—paper thin layer of skin containing

of long strips of epidermis including portions of the cutis

In examining closely the many articles written by various authors upon the subject one is struck by the complicated methods advised both in dealing with the area to be grafted as well as with the area from which the grafts are to be removed. Emphasis is laid upon the means of rendering the field of operation aseptic and especially among the earlier writings very complex technique was elaborated with detailed directions for using antiseptics scrubbing the skin and at the same time removing solutions such as bichloride of mercury that might lower or destroy the vitality of the delicate grafts. To quote from a few articles

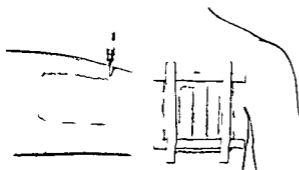
Crooke (2) uses the use of antiseptic irrigation in preparation for grafting, or if the granulating area is sluggish and indolent the painting with iodine and 25 per cent balsam Peru in castor oil. The operation to be done under general anesthesia. Grafts when cut are put in saline and later floated on to oiled silk. Brad grafts are performed for drainage purposes but healthy granulations are not treated.

Edward M. Foote (5) says: The site from which grafts are taken should be cleaned with soap and water and washed with saline and then surface to which they are applied should be fresh and wiped free from all odour, emphasizing asepsis without the use of germicidal solutions.

Henry R. Whorton (6) s y Surface from which
grafts are to be taken sh uld be rendere r septic [det its
not u en] All antiseptics are w h d away u til ste
s it s luti n Before applying grafts the an uling
urf ce should be curett d to remov soft granulation is
irr gtl l and c vered ith pr tect nd a compre
ap pl i to cont of ble lins Sh vin of kin are th n
emo ed f om a surface by ha leen rend red aseptic
[again detail] rel chin l by a ra or r knife

W B ch () l i s e s the use of bichloric in preparing the ar a (translating should be applied rule be off end haemo rhage rsted Then ar apl d craping f om the pati nt a donor or blste s or placental mbrane He firth r em rks that ucc e i best a u c l (r) by th proper p e r at n of the o n l to l graft e l () the st ge of h l n r c h e l b c f o the grafts a e r p l i c l () the l e c t o n f k a t f r m g r n t i e e f m g n o r t h a o s y h l (that is y h e n j c n t a l m e m b r e i n e m p l o y l) (4) t h e u c f l a c n t m e m b r a n e i f t d h i r a n d (5) i v f t e - c a r n i l m a n g m e n t l e r l i n g r a f t a r e a l e d y n T h e r e f o r t h s b y n o t h a n l W l f e r f t e d y t h i r l B t u n g f t h k i n t o c u p l t h a (I n d i n m e t h o d) : s a n c t i n e l b y H i r c h e r g

Thi s p r o c e d u r e r e c o m m e n d e d b y W a l t e r R. F a r k e r (3)
c o n m e r c i a l a t l a r a r e a s h e a n d c u l
a r f l i c h o r y a n d a t s p o n c v t t l a c h l
b e h l i c H a r r i n t o n s o l u t i o n a n d a h u t l s a l i n e
n l p l y l r i n g s



I g M t l l t t k k t l l c ft
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 C t l l A l l (S) k k t l l k k l
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The efficiency is sufficient to show the diversity of opinion to the way in which the technique of skin graft application is and after care everywhere different. Numerous authors describe various techniques. There is no standard procedure which would be to one mind the difference of opinion in my method.

Some authorities have recommended that the graft be left in place until it has become covered with a new layer of skin and then the graft be removed. Others recommend that the graft be removed immediately after it has been applied. I have found that the graft should be left in place until it has become covered with a new layer of skin and then the graft be removed. I have found that the graft should be left in place until it has become covered with a new layer of skin and then the graft be removed.

The greater the simplicity of any method of surgical procedure the more likelihood of its general successful utility and adaptability.

The method of skin grafts as adopted by the writer was suggested in 1909 by an article by Dr. I. K. Macmillan (9) of Amsterdam, New York, and the various steps in simplifying the technique about to be described followed as a result of experience in applying grafts in a series of some 60 or more cases at the Methodist Episcopal Hospital. The cases were taken as they came to us and included grafting secondary to ulcers, burns, carbuncle, carcinoma of the breast, tuberculosis of the breast, gangrene of toes from frost bite, etc.

The area to be grafted should of course be in healthy condition and it is courtin failure to attempt to apply grafts until such areas are right. We have found that no time is lost by sufficient attention to the pre-operative care of unhealthy granulation, exuberant granulations, small area of lough persistent infection, etc.

Sloughy area should be stimulated with talcum, naphthalene powder, pre-operative cure, exuberant or uneven area should be treated with silver nitrate stick or curette. Lough should be cleared away by curette and moist dressing and infection line away with before any graft are applied. A few days or week even if delay is time saver in the end. The surface does not apply to fresh wound surface. Only when the granulating area is flat and healthy or in fresh wound should the operation be attempted.

Autogenous grafts are the one of choice and are usually taken from the outer and upper surface of the thigh. The layer preceding the operation a wet dressing of formal solution is applied to the donor and recipient area and the thigh or thigh are washed with alcohol and sterilized. Compression is applied. When the patient is brought to the operating room pre-arranged having had a 4 or 5 grain of morphine the granulating area is washed off with a stream of saline solution are being taken not to damage the granulating surface by the use of a curette. The sterilized sheets and the donor area. The thigh is prepared by painting with a 1 in 10 coat of 1 per cent iodine solution and similar sheet in 1/2 w/ put in place. No other lotion, antiseptic, etc. are used. The chief advantage of this method is its simplicity and ease of application. Small areas can easily be operated upon without an assistant or any elaborate operating room paraphernalia.

The size of the skin surface necessary for removing the graft for which the Thier method is preferred is determined and outlined in one's mind. Next with a solution of 1 per cent novocaine the four sides of the recipient area are injected endermically or if the area is rather than 6 or 8 inch square a second similar square can be injected and are then cut. One should not be hurried and plenty of time should be allowed for the novocaine to act—at least five minutes. With the skin made tense by one hand of the assistant above and the left hand of the operator below the surface kept wet with saline solution or steril water dropped from a sponge by the assistant, free hand generous Thier grafts

are cut with a sharp flat bladed razor with a slow steady to and fro stroke of the knife cutting at right angles to the long area of the graft. The grafts are applied directly from the razor blade to the granulating surface or wound being caught gently at the edge by forceps and the blade being drawn steadily away allowing the graft to slide into place. Enough grafts are taken to entirely cover the wound but in no case should they overlap. It is even better to have small uncovered space between the grafts to allow for the natural drainage from the granulations.

Graft dressing consist of a single layer of sterile gauze sufficiently large to overlap the wound edge an inch or so. This applied firmly smoothly and evenly is held in place by long strips of sterile adhesive at the four sides reaching beyond the gauze and adhering to the healthy skin adjacent. A good substitute for adhesive is the use of collodion to cement the edges along the four sides. Here again we have the simplest kind of dressing and one available to any surgeon in any emergency.

The after care of the skin graft is simple. The gauze is left undisturbed in its place for five or ten days or until the graft are closely and firmly united. Over this single layer of gauze are applied dry sterile compresses held in place by adhesive straps or bandage. The dressings are to be removed daily, the under layer of gauze being left undisturbed and being washed thoroughly by a stream of sterile water to remove all injurious and irritating wound discharge. Dry compresses are then re-applied. The thigh is dressed with boric acid ointment on compresses which dressing is not disturbed for a week or ten days at which time when it is removed the skin will be entirely healed only a bluish surface remaining as a reminder of the graft removed. When the grafts are firmly attached and the discharge has ceased the ordinary in

a week or ten days the grafted area is left exposed to the air clothing and bedding being kept from direct contact by a ring of gauze or cotton. A little dusting powder such as stearate of zinc will aid in drying up the few excreting surfaces remaining between the new grafts.

From our experience we can say first that 5 per cent iodine is used to render the thigh aseptic in no way destroys the vitality of the grafts. We confess that we had some doubts as to such effect when this step was first instituted. Second with ordinary gentleness and with care to avoid haste and to prevent the patient from giving way to his natural timidity and with almost unlimited use of a weak novocaine solution as advised grafts can be removed of sufficient size to cover very large areas. Third the single gauze dressing allows daily irrigation of the grafts and the washing away of the discharges that have so often proved destructive to new grafts. We have on one occasion at least succeeded in obtaining taking grafts when a purulent discharge was present from underneath the grafts at the time of their first dressings.

We do not claim that no failures are to be expected if this method is carefully followed but we do emphasize again its simplicity and ease of adaptability and recommend its use on the ground

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POSTOPERATIVE THERAPEUTICS OF SURGICAL INFECTIONS

By DR GIOVANNI COCCI AREZZO ITALY

IN the preliminary note I wish to set forth the results of observation, studies and experiments which I have been carrying on for many years (1906 until now). During this time the methods of treatment used have been gradually modified and in my opinion improved until now they are quite similar to those in use today. Perhaps however they represent only a stage in the progress toward better and more perfect methods. My observation studies and experiments have been carried out on hundreds of patients who have been under my care in the surgical wards during the time that I served as assistant, assistant director and director of the surgical department.

Taking as my motto the classical dictum *primum non nocere* it appeared to me that the customary method of treatment might in many respects be modified and improved and that we could do more toward a healing nature in curing infection which is the necessary goal in all methods of treatment whether medical or surgical.

As is shown by the title of my paper I wish to deal with all the curative measures to which the patient is subjected as soon as he leaves the operating table. The methods are mentioned consecutively and follow two different but equally important paths: the local treatment of the region which has been operated upon and the general treatment of the patient.

In other articles which will appear later I shall describe in detail the technique. I have made the knowledge I have gained from the experience of other and hundreds at length the reasons which have induced me to apply methods which differ considerably in many particulars from those generally used. My intention in the present note is merely to describe briefly my system of treatment and at the same time to touch upon the result obtained.

Local treatment. The local treatment consists in the so-called dressing of the wound. This is usually an extremely simple task but one which is often on the contrary a matter of extreme delicacy and one which determines the course of the disease for the life of the patient or in any case his future health. In almost every surgical case depends more upon the subsequent treatment he receives in the surgical ward than upon the operation itself.

The technique which I have found to be the best may be summarized as follows. First I avoid the use of antiseptics. On the other hand except in cases of unusually severe infection with peculiar pathology I use heat. Heat may be applied when the patient is still under the influence of the anæsthetic by means of red-hot iron instrument with large surfaces of different shapes which instrument retain the necessary temperature better than does the ordinary thermocautery. I apply heat not so much to destroy the germs as to act upon the diapedetic tissues. Strict aseptic precaution should be constantly taken. The instruments should be sterilized for each successive dressing. When necessary irrigation should be carried out by means of sterilized water and the dressings in every case should be of sterilized gauze which should be placed in contact with the diseased parts by means of instrument avoiding except when extremely necessary touching the wounds with the hands which should always be covered with rubber gloves.

Scrupulous care should be used in cleansing the parts about the wound and the suppurating cavities. Accumulated secretion, necrotic fragments, crusts, the products of cutaneous desquamation etc. must be carefully removed at all time using the utmost care to avoid hæmorrhage. It has been found that the best method of effecting laceration is by means of irrigation with hot sterilized water under a certain pressure and by washing the parts around the wound from time to time entirely but carefully with soap.

I abolish all so-called drainage by means of gauze or India rubber or a combination of the substance except in very peculiar cases such as large cavities produced by abscesses (empyema etc.). Even here however drainage by means of an India rubber tube is only necessary in the first stages. Instead of drainage I introduce into the suppurating wounds previously sterilized paraffin (melting point 48°C) liquefied by heat. The paraffin is applied with a large glass syringe and is carried into the smallest and the most remote recesses of the wound. The wound cavity is thus filled with paraffin completely up to the level of the skin. Around the wound and for some distance from it previously sterilized white vaseline which has been kept hot and ready for use by means of heat in a water

bath is liberally applied Paraffin is used freely in the dressing of flat sores the granulation tissue being also covered with it

All flat sores are dressed with dry sterile gauze which is changed as seldom as possible unless there are special symptoms (fever pain etc.) which would indicate that the wound is not following its usual course

As far as possible the diseased parts should be kept at rest and immobilized by means of suitable bandages apparatus special postures etc.

The description given outlines the chief points in the method which I have found the best in practical surgical after treatment I have arrived at this method after the careful selection of each step Guided by the experience gained in my daily practice I have thus reached a complex of technical details which realizes the type of dressing which I should like to call if permissible physiological dressing by which term I wish to express the conception upon which the method is based

Treatment consists in the first place and principally in not disturbing or hindering the development of the patient's natural resources for defense and in the second place within the limits permitted by necessity to which too much attention can never be paid treatment consists in promoting the natural processes without doing more or acting otherwise than Nature herself

As stated above I reserve for later articles the detailed account of the studies and observations which have guided me in the above mentioned arduous task of election In this paper it is my wish to treat only briefly of matters relating to the two points in my technique which differ from the technique usually employed namely the abolition of disinfectants and of drainage appliances After having experimented with numerous disinfectants and having employed them in different ways for the purpose of acting on the germs within and about the centers of infection I am convinced that either they have no effect or else the damage they do to the tissues is greater than their hypothetical destructive action upon the germs

There are three central points as regards the disinfectant (1) A first their antiseptic power is concerned it is illogical to suppose that a compound which is fixed and constant in every case should be a panacea for all diseases and should act in the same manner upon all germs in every stage of virulence and upon all tissues

(2) Regarding their action upon the vitality of the tissues as opposed to this same can't they of composition and the intensity of the action of

these substances there are certain tissues whose degree of vitality and of resistance to external agents varies within the widest limit, both in the case of the same individual at different stages of the disease and in those of different individuals and diseases (3) We apply disinfectants to a part and generally a very limited part of the center of infection and to one plane of it so to say to the cavity made by our knife or by the point of the greatest fusion of the purulent tissues It would thus be unreasonable to expect that the center of infection should stop where our knife has stopped and that germs should exist only upon the surfaces exposed As I shall clearly show germs are to be found which is but natural diffused among tissues at the greatest distances from the surfaces acted upon and therefore what can be expected from a substance that affects only a very small part of the infection center of the disease?

After having tried all the systems of drainage I am convinced that it is a pure delusion to suppose that as a rule it removes from the depths of the infection centers the pus which has collected there and which comes out in spite of our drainage though drainage may sometimes have a favorable effect by exercising a totally different function I have therefore been forced to believe that the best way to drain an infection center is not to drain it at all

The paraffin introduced according to my system might seem at first sight almost to form a plug which would hinder the pus coming out but this is only a supposition that does not agree with the facts In reality the paraffin which solidifies after its introduction does not adhere at all to any part of the surface with which it is brought into contact just as it does not adhere to the skin but while it holds widely open the center of infection which has been exposed it penetrates into the furthest interstices and remotest parts and thus prevents any accumulation of pus there because there are no longer any dead spaces where pus can collect On the contrary as pus forms it gradually runs along the walls of the cavity of the abscess in the space between them and the paraffin and reaches the exterior where it is collected by a suitable absorbent dressing

General treatment It is necessary to bear in mind always but more especially in the particular infections the general clinical precept which calls for the frequent careful and scrupulous physical examination of the patient during his illness and especially if the course of the wound becomes irregular Only too often do we persist in attributing to the usual internal

causes a fever and a gravation of the disease which cannot be explained by local causes to find afterward the symptom is due to the presence of metastatic centers of infection or to visceral complications the course of which might have been arrested had they been recognized and dealt with on their first appearance.

After this our attention should be directed toward strengthening the natural means of defense possessed by the individual and we should be guided by a knowledge of the manner in which immunizing reactions work for if in slight infections a suitable hygienic dietetic treatment of the afflicted one is all that is required in the more serious cases in which the most robust patient is often reduced in a few days by means of rapid parenchymal degeneration to a condition of complete anæmia we should give all our attention to strengthening and exciting the normal method of defense though unfortunately we must acknowledge that the means at our disposal for this purpose are very limited. On the other hand it is my conviction that in the serious cases we should direct all our effort toward the general treatment of the patient rather than local treatment of the disease center for it is only through the blood and the natural immunizing means of defense that we can hope to conquer the infection. Since we can expect only very slight improvement from the use of so-called physical local remedies (crisis, employment of hygienic, dermatologic continued practice, physical etc.) although useful to great advantage in the treatment of complicated hemorrhage and since the use of chemical metals, nuchlinic acid and of the injections of corrosive sublimate and of all the preparations of this kind have proved to be at least ineffectual I believe that it is only from biological therapeutics that we may hope for any practical result. Along this line there is a vast field open for study and investigation.

It is to vaccine therapeutics and to serum therapeutics that we must turn and we are fortunate indeed when in this field the course and nature of the disease allows us to use a really specific treatment and tend to the proper institute the varieties of the pathogenic germs from which the biological remedies may be prepared. These remedies have proved in my experience to be much more constant and efficacious in their action than serums and polyvalent vaccines. I use normal horse serum when the urgency of the case and the gravity of the disease admit of no delay in treatment. The serum should be used liberally in doses of 10, 20, 40 and up to 80

cubic centimeters *per diem* and in the form of intravenous or subcutaneous injections preferably in the neighborhood of the center of infection. The injections should be repeated for many consecutive days and also on the first indication of the disease becoming worse.

In mentioning the results that I have obtained it is necessary to remind the reader that though my experience until two years ago was limited to the treatment of ordinary surgical disease for the most part abscesses, phlegmons and osteomyelitis together with a few cases of purulent arthritis and of open infective fractures it has now been extended by the large amount of practice I have had in an exclusively surgical field hospital (5733 U. S. Army Corp.).

As is well known in this great war the wounds caused by projectiles on the one hand and those due to freezing on the other have unfortunately given an enormous number of surgical maladies of which not a few are of extreme gravity and are not met in civil practice. It is just in this new period of my surgical career that my experience in this field of surgical therapeutics has been completed and I have been truly and valuably dealing with an extraordinary number of patients with the efficacy of the method I have adopted as compared to others now employed. In the great disease centers of exposed infective fractures in interminable articular suppurations as in all wounds that have suppurated for a long time where there is accumulation of pus it is often necessary to intervene in order to provide new points of exit for the matter which flows along the muscular interstices and infiltrates the spaces about the sheaths of the tendons thus exhausting with long suppurative fevers the very strongest constitutions. I have found the paraffin treatment has proved itself extraordinarily efficacious without wishing to ascribe any special curative effect to the paraffin. Nevertheless I firmly believe that when it has been used the course of the disease is shorter and there are less complications than when other drainage methods or local treatment is used.

As to the terrible gangrenous infections so often accompanied by rapid epidemicæmia I have succeeded by the free use of the red hot iron applied locally and the liberal use of normal horse serum as a general treatment in saving cases that otherwise would have terminated fatally. I wish to insist especially upon the efficacy of horse serum for although there are some hopeless cases in which this remedy has proved of no use in the majority the result

obtained with it has been most successful and have manifested themselves in the rapid fall of the highest temperature to normal the improvement of the general condition and a change in the appearance of the surface of the wounds. Similar improvements have hitherto not been obtained by the use of any other means.

I am further strengthened in my conviction regarding the efficacy of my method when I see the discouraging results which follow the em-

ployment of the numerous remedies from hypochloride used for irrigation and as a permanent bath to the injection of oxygen of oxygenated water or of mixtures of powders which have been recommended as of undoubted utility. I have not found either that general treatment by means of hypodermoclysis proctoclysis colloidal metals and polyvalent serums has proved any more successful although the necessary surgical aid was given early and skillfully.

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Books received are acknowledged in the department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

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AMERICAN COLLEGE OF SURGEONS

CONFERENCE ON HOSPITAL STANDARDIZATION

JOINT SESSION OF INTERNATIONAL STATE AND PROVINCIAL COMMITTEES ON STANDARDS HELD IN CHICAGO
OCTOBER 19 AND 20 1917

HOSPITAL standardization during the last ten years has been much discussed in the medical profession and among hospitals. During this period such a project has steadily won favor in fact due chiefly to the American Medical Association and to the American Hospital Association the need of it is now almost universally conceded. Already hospital standardization has found expression in Pennsylvania and New Jersey. But the first continent wide plan of action in this field was announced by the Regents of the American College of Surgeons in 1911, soon after the organization of the College and that plan of action is now a reality.

The Journal is pleased in the following pages first to review the steps by which the College has entered upon its program of hospital standardization second to give in abstract the papers presented at the hospital conference held in Chicago on October 19 and 20.

Although a program of hospital standardization was announced by the College in 1913 the Regents of the College at that time could not take up the project. Necessarily they turned their attention first to the organization of strong Credentials Committees in each province of Canada and in each state of the Union. A second task was to secure a sound financial basis for the College. But when in 1916 these two objects were fairly accomplished the Regents asked the Fellows of the College to elect committees from their own number in their respective states who were most thoughtful on matters of educational standard.

The purpose of the committees was not only to guide but also to put into action the

standardization project. It was the intent of the Regents as soon as these committees were elected to call them together and with them to act. Delay in this plan however was caused by the war and the committees were not called together until October 19 and 20 1917. On these two days the committees met in Chicago and about 60 leading hospital superintendents also met with them.

At this conference the problem of standardization was approached first from the angle of actual hospital data: the number of hospitals their distribution their classification the number of beds the investment etc. Together with these data came also some thought as to the relation of these hospitals to the society served by them. The second division of the program had to do with what the profession of medicine wants in hospitals. Under this division were considered efficiency and management the hospital laboratory case records and their value and the responsibility of the hospital toward medical research and in the training of interns and of nurses. The last two sessions of the program were devoted to the ways and means toward action. In this connection the viewpoint of the American Hospital Association of the Catholic Hospital Association and of the medical schools was each presented and discussed.

WHAT THE CONFERENCE DID

The outcome of the conference in general terms was as follows:

First the idea of organized standardization advanced among those present from a mere intellectual conception into real enthusiasm. Second the interest in the project was shared by hospital administrators

SURGERY GYNECOLOGY AND OBSTETRICS

whether they came from little hospitals or from great hospitals as well as by physicians and surgeons. Third the proper care of the patient was throughout all of the papers and discussions held as the test of efficiency in the standardization program. The hospital is for the patient it is for his convalescence and complete recovery from illness. The right sort of care of the patient it was emphasized could be provided in a small hospital as well as in a great hospital. Fourth time and time again the need of closer cooperation between hospital staffs and hospital trustees was urged and the need also of strong administrative authority. Fifth firmness in all procedure and quick action were judged fundamental to successful policy.

Finally in order to translate the conclusions of the conference into action a General Hospital Committee composed of 5 members surgeons internists hospital superintendents and laboratory men and other specialists was appointed to meet at an early date in Washington. This Committee is to do two things. First to review and complete a questionnaire upon which data concerning hospitals are to be collected. Second to review and to approve a minimum standard on the basis of which hospitals are to be classified. This minimum standard is to include definite requirements on such matters as the keeping of case records the hospital laboratory and the training of interns.

In the closing summary of the conference on October 30 Dr. George W. Crile said in part:

The first great step toward standardization has been achieved for those of us who are here have ourselves been standardized. We are a difficult group to standardize but the thing is accomplished.

One thing I have learned from this meeting which is more important than anything else is that medical staffs should realize fully that they are public servants that they are in private practice only in part and that they owe a duty toward the training of young men in hospitals. They owe a duty to train nurses as well as interns and assistants. It is the duty of medical staffs also to give an insight to give a spiritual viewpoint to mem-

bers of their respective boards of trustees in order that the staffs of hospitals and the trustees may work together with all the advantages of strong bonds of cooperation.

I have listened with great interest particularly to what has been said about small hospitals. So far as I am personally concerned the standardization that is in our minds here to day is not the standardization of the great institution. High scientific service in a hospital does not necessitate a large number of beds. It means merely that if a hospital has but one patient and one member of staff that if the member of staff gives that patient a fair show and a square deal in the way of intelligent treatment the hospital will meet any standard which we may properly set up. The patient must have the advantage of medical science the advantage of a laboratory and the advantage of good nursing.

I desire to mention a matter that concerns this problem which I learned much to my advantage in Iran. For the first time I spent all of my time each day in a hospital. Heretofore I have had a great many duties outside of the hospital to take me away from it. In spending my time all day in a hospital I had excellent opportunity to see more closely the thing that make for real success. I do not believe that we as surgeons realize how little attention we actually give to our own hospitals. I did not realize it at least. Now I know that there must be a whole ocean of things going on in my own hospital that I should concern myself about.

And not only should we concern ourselves about our hospitals but to a greater extent we should concern ourselves about our trustees. We should interest them in such a fashion that they will come gladly to the meetings and that they will give us their most careful judgments on the intricate problems that arise. We must have all of us one set of ideals throughout all departments.

We are now at the beginning of a tremendous expansion in altruism and of a keener understanding of our duties toward the community. The success of the whole project lies within ourselves.

During the last session of the conference

Dr William D Haggard Nashville especially struck home the part which the State Committees on Standards must play in the project. He said in part:

I make final appeal to you individually that when you go back home you have frequent meetings of your committees and that you present this whole matter to your various medical societies and particularly to the members of your governing board and to the people of your communities. Hospital trustees are kindly people but they do not actually give the same active and intensive interest to the hospital problems with which they are charged that they give to their individual business. The fault lies largely with the profession. The doctors have not educated the trustee to their duties. The very foundation on which we may hope to build success lies in the interest and team work which we create among the hospital trustees.

STATEMENT OF SECRETARY GENERAL

Because of illness the Secretary General of the College Dr Franklin Martin was not present at the conference. He sent however an introductory statement to the conference in which he recommended the appointment of the General Hospital Committee and made other most helpful suggestions. His statement in part follows:

There is nothing insurmountable in my judgment in the standardization of the hospital of this continent. It is a matter of organization or organization that attacks with courageous force the roots of the problem and not its branches and twigs.

The fundamental elements of this work are first the patient second the doctor who treats the patient third equipment and intelligent administration fourth adequate nursing facilities fifth diagnostic laboratories in charge of a practical laboratory man. These five fundamentals form the basis of the concrete structure which we are to approach.

Assembled here today are members of our State and National Committees. We have with us also leading hospital superintendents. You are men of force of intelligence and of executive ability; you are quite capable to formulate a plan of minimum efficiency that may be applied to each class of hospitals. This is one of the tasks for which the Committees of the College were elected and not only one of the tasks but the *paranormal* one. With our Director and by ourselves now this plan is to be developed. At the end of one year at least one thousand hospitals should be published in their definite groups as Class A hospitals according to the standards of the American College of Surgeons. We have no compulsory power over hospitals that do not enter into the program with us. But we have with us the strong support of some 4000 Fellows and the force of public opinion because what we want is right.

Let me say that the standardization of hospitals covering a continent can be accomplished only by firmness and by the untiring exercise of the courage of our convictions. Let me urge also that swift action inspires confidence and defeats opposition.

HOSPITAL CONFERENCE IN ABSTRACT

THE HOSPITAL AS THEY ARE

In the following pages the paper presented at the hospital conference are given in abstract.

Dr JOHN A HOPKINS in his article "The Hospital Problem of Today — What is it and that there are in the United States \$66, in titution for the care of the sick having a total of \$8,111,111. The e

are general and special acute disease hospital. In New York City there is one hospital bed to every 1,300 of the population in Ohio taking the state as a whole there is one hospital bed to each 300 of the population while in the state of Texas the proportion is as 1 to 400. The total amount of money invested in hospital building and equipment in this country is \$144,191,500. The per

capita cost for the maintenance of a patient in the hospital of this country ranges all the way from \$1 per week up to \$1,00. The total annual expenditures for hospital maintenance amounts to \$453,917,657.00.

Eleven per cent of the people who were sick enough to be under a doctor's care in four counties in the state of New York according to a survey were in the hospitals and about 80 per cent were attended at their own homes.

In the light of pathological bacteriological and the X-ray aids to diagnosis 90 per cent of the people are deprived of the best services during sickness.

No hospital can be better than its medical staff and no medical staff has a right to expect evaluation of its abilities higher than the prima facie evidence that is in the equipment and in the methods employed in the workshop in which their work is done. We all know institutions elaborate in architecture great in size and rich in endowment that are mere boarding houses for the sick and we know that in many of these institutions the medical staff is mediocre without ambition, energy or enterprise. We all likewise know small isolated institutions far out in the country small in size poor in worldly goods and almost without equipment or fund with which equipment may be bought whose service to the sick is of a high scientific order and in which the sick man, woman or child may have at his need the best that modern medicine offers.

In perhaps 75 per cent of the hospitals in this country large and small general and special the record as it is kept today is practically valueless. In many of the hospitals the scientific auxiliaries to diagnosis are not employed and medical treatment and surgical interference are undertaken after the most cursory bedside examination. The only part of the medical record of patients in a vast majority of the hospitals is the nursing chart. It is rare indeed that we find a running continuous medical story of the progress of the case written from day to day in the record. There are spasmodic attempts in the class of hospital to make and record urinalyses in special cases and

an occasional record of other laboratory examinations is found but it is not routine practice.

The employment of inexperienced and incapable persons in the scientific departments such as the X-ray pathology and dietetics is a thing which should not be tolerated yet many hospitals are today following this plan. It is certainly dishonest to the community and to the medical profession.

Nearly all hospitals have the old formulae of special diets. We know however that most of these special diets are valueless and that in the light of studies in metabolism and in the physiology of digestion they are based upon wrong principles and exploded theories. Yet we find these special diet charts in the serving rooms of nearly all hospitals and in many of these they are exalted into actual fetishes. On the other hand in some institutions with well trained dietitians the medical profession fail to avail itself of their service.

It has been the complaint almost throughout the country for a long time that the hospital is a place for the millionaire and for the pauper but that 90 per cent of the population people in moderate circumstances who would refuse charity and cannot afford the luxury of the modern hospital have been without consideration. Those of us who have been closely in touch with modern hospital practice know that this indictment has largely been true. This class of patients is coming to realize however that the hospital is not a hotel with the special function to administer to dainty luxurious appetite for rich and costly food but that the plain and simple things agree best with sickness and agree best with most patients.

One of the very greatest deficiencies in our hospital record and consequently one of the most important items of hospital and health statistics is the almost total absence of follow up work. Surgery is successful only as a permanent cure or as a definite preannounced period of relief. Many patients get well apparently and go back to their homes greatly relieved following a surgical operation only to have the disease recur

after a brief interval of relief. This means that measures must be taken by the hospitals of this country to follow patients back to their homes and to a period of complete cure — or to recurrence — before the record of the patient can be completed and reported for the purposes of literature.

DR EDWARD MARTIN in his paper "Relation of the Hospital to Its Community" states that the modern hospital has advanced more rapidly in the past ten years because medical efficiency has advanced more rapidly in that period of time.

Hospitals were founded on a broad charity. There were communal hospitals and city hospitals. The state hospitals were founded with approximate indifference to take care of those who could not care for themselves. Then came the altruistic hospital. There were men who strove to make life less miserable for others by giving freely their dollars and their efforts toward these hospitals. Then came the scientific teaching type of hospital. Medical schools found this type of hospital very vital for teaching purposes. Then followed the purely scientific research hospital, a splendid institution.

When a man graduates from a medical school and has an academic degree, he is only 20 per cent valuable to the community. When he gets through a good hospital, he is of real value. He works and is not diverted. There are graduates in hospitals who state that the facilities and equipment of the institutions with which they are connected are poor and inadequate that no one in particular cares how the hospital is conducted. Such hospitals should either raise their standards or should not be tolerated by their communities. Such hospitals do harm.

In Pennsylvania Dr. Baldy succeeded in raising the hospital standard through the Bureau of Medical Education and Licensure. In one week he had accomplished what hospital states had been trying to do for five years. Through his influence the hospitals put specialists on their staffs. X-ray men, laboratory men, etc. His chief weapon to force hospitals into line was that unless these hospitals accepted a certain standard they could not get resident physicians.

In the matter of standardization, what is the very foundation on which a hospital rests? The answer is that the hospital is for the patient. It is for his smooth convalescence and complete recovery. As it means to this end, it is most important that hospitals be managed by trained superintendents. The first step is to establish some school for the training of hospital executives. Fundamentally, that will be a medical education plus a hospital residence ship and after that intensive training in hospital management. The time is ripe for it. Another point in the standardization of hospitals is the keeping of a complete set of records which give essential data as to the care of patients and the final results of treatment.

II. WHAT THE PROFESSION OF MEDICINE WANTS IN HOSPITALS

DR. JOHN YOUNG BROWN on "Hospital Organization and Efficiency" says that hospitals are established for the purpose of rendering better service to the sick than they can obtain in their homes. The most successful hospital is the one which is conducted primarily from the ideal standpoint of the best professional service to its patients and *not from the business standpoint of hospital economics and financial deficit or surplus.*

Many hospital superintendents realize the necessity of being able to control fully the standard of treatment which patients in their institutions should receive. Only a few superintendents are today endowed with sufficient authority in this matter. Unfortunately, there are too few superintendents capable of exercising intelligent and judicious supervision in medical matters.

At the present time the legal restrictions in the various states are not sufficient to guarantee the proper standards of surgical excellence. The hospitals are in a position to refuse to become a party to other than competent and skillful work in the handling of the unfortunate sick in their charge.

A position on the board of trustees of a hospital is a great public trust. That trust must be observed and realized to a greater extent.

The medical profession should be satisfied only when our hospitals are conducted with the sole idea of what is best for the patient.

Since the laity by the very nature of things expects these obligations to be discharged by the hospitals why should not a properly conducted hospital fulfilling its every obligation to the patient make known to the community through proper channels its position in the matter of incompetent physicians and surgeons and be rewarded with the increasing gratitude and confidence of its patients.

The minimum of responsibility which the hospital may rightly assume is that which its board of trustees would wish any hospital to assume toward themselves as patients.

DR FRANCIS CARTER WOOD in *The Hospital Laboratory* states that the standardization of hospital laboratories implies the standardization of the profession as well and that such a reform invariably meets with opposition from the very persons and institutions that need it most. The best laboratory equipment and staff will be of no avail unless cordial support is given to the workers by the clinical staff and unless intelligent use is made of the reports furnished.

The functions of the hospital laboratory may be outlined as follows. First and most important to offer to the attending physicians and surgeons such information as will assist them in caring for their patients in the best possible manner; second to furnish facts which will be of educational value to the physician or surgeon himself, his staff of interns, professional guests and students; and third to advance the arts and sciences of medicine and surgery.

While many hospitals give good service as far as staff and nursing are concerned but few of the hospital laboratories in this country fulfill all their functions for reasons which are obvious: first lack of money for laboratory salaries and equipment; second lack of control over patients and difficulty in obtaining autopsies; third scarcity of well trained men to study the patients when the latter are available.

The following headings are discussed

1. What is the irreducible minimum of laboratory equipment both in apparatus and in personnel without which the patients of the hospital will receive inferior treatment?

2. What is the mean or average equipment for a good hospital of two hundred beds?

3. What is the ideal?

Under the third heading the author states that the ideal institution should have facilities for observation and investigation of patients in collaboration with the clinical staff which must be possible to the workers of the laboratory if the highest achievement is to be reached. The pathologist himself should be a full time man of high research ability and if possible with some teaching connections which will without absorbing too much of his time keep him in touch with students and members of a university staff. He should rank in the hospital as an attending physician in order that he may have sufficient authority over the interns and nurses to obtain such specimens as the study of a case may require. He should have ward privileges so that he may have a bed or two for metabolism work. One of his assistants should be an assistant attending physician to the hospital, the other an assistant attending surgeon and both should be on one of the regular services so that they have full access to the patients in the wards. This brings the wards to the laboratory and the laboratory to the ward. It trains two men who will be ready after four or five years to step into responsible clinical position with far better knowledge of medicine and surgery than the average hospital graduate. The opportunity of seeing the patients stimulates interest in the laboratory work and the patients are helped because the laboratory work is better done.

The secret of successful research is not in money or buildings. No great work is ever done in research except by a great man and the American method of assuming that a large income will produce valuable scientific returns is not wholly warranted.

DR E. A. CODMAN in his article *The Value of Case Records in Hospitals* gives the following

Every time treatment whether operative mechanical or medicinal is given an experiment is performed. It is no less an experiment because it is made on the human subject. In every experimental science records are made of each trial giving all necessary details and especially noting the result. Singularly enough in these human experiments it is not usual to make special effort to see that the results are systematically recorded even though the details of the operations or treatments may be written down in the clinical records. If we were using dogs in the numbers that we are human beings there would be a great cry raised against our brutality for causing needless suffering. The truth should be recorded even if expediency keeps the records under lock and key.

Case records are made for four purposes first for scientific purposes second for practical purposes third for medicolegal purposes and fourth to form a basis for study to increase the efficiency of the hospital.

It is a singular fact that the last idea is a relatively new one. Heretofore trustees have been content to know that their patients have been treated and cared for.

In hospital organization we may profit by the teachings of the modern science of efficiency engineering.

The important facts under the eight headings which follow should be known about each case in all hospitals.

- 1 A permanent address of some relative or friend who would forward mail a year or more later.

- 2 The symptoms or condition for which relief was sought.

- 3 The diagnosis accepted as a basis for treatment by the person responsible for or giving the treatment.

- 4 The name of the person who took the responsibility of treating the patient or the names of those to whom he delegated important steps in the treatment.

- 5 The important points in the method of treatment whether operative or otherwise.

- 6 The complications which resulted from during or after treatment.

- 7 The final diagnoses at discharge authoritatively O. K. d. for index filing.

- 8 The result when time has elapsed for this to be determined or a brief annual statement of the patient's condition.

DR ALLEN B. KANAVEL in writing of The Educational Responsibility of the Hospital to the Profession and to the Community has this to say:

The educational functions of a hospital may be grouped in four divisions first as to interns second as to the staff third as to the profession at large and fourth as to the community.

A hospital should teach its interns first medical knowledge second ideals third thoroughness fourth imagination. It is the duty of the staff and hospital authorities to cultivate all of these.

In this material age care should be exercised to choose a staff wisely. Hospital trustees should realize that the possession of a large practice is not necessarily the badge of efficiency in the profession and that if they choose their staff on the basis of income to the hospital they may soon awake to a realization that the standard has been so lowered that it has lost the confidence of the profession and of the community. With the general diffusion of medical knowledge the laity is rapidly learning to demand thorough training of the physician.

Every hospital staff should demand and every hospital furnish all known equipment for diagnosis and scientific work. As a protection to themselves hospital trustees should urge postmortems for all patients dying in the hospital and the staffs should have the scientific honesty to support the demand.

All hospitals would be better for some university supervision and would certainly develop a higher function if they acted as the teaching center for their communities. This would raise the standard of the hospital center professional life about it and develop the profession as a whole.

The public has unstinted praise for knowledge and in proportion as our profession demonstrates a real scientific spirit the moral and material support of the community may be expected. The laity must be taught by lectures and demonstrations under proper auspices. To win the confidence of the

public the staffs and the trustees of the hospitals must have the right ideals in medicine. Efficiency of the one and service divorced from material advantage on the part of the other must be our ideals. Dividends must be sought in scientific knowledge in the cure of disease and in the amelioration of human suffering, rather than in dollars and cents. But let no one doubt the latter will follow inevitably in the train of the former.

Miss ANNIE W. COODRICH in speaking of The Trained Nurse says: The most important questions for consideration today are: first, what is the function of the nurse; and second, what content of education will equip her to fulfill this function.

The nurse is a remedial agent whose services calling her to all classes of society at frequent intervals and in intimate and prolonged association is thereby afforded an almost unlimited opportunity for health education which is the keynote of preventive medicine.

We are quite familiar with all the arguments relating to the impossibility of including in a three years' course all of the sciences required for a sound educational foundation and all of the special and knowledge of which would of course be desirable. The scientific foundation should not be left for these three years. Students should not be permitted to enter school of nursing who have not completed the course in a secondary school or a recognized equivalent. Both in the secondary schools and in the colleges are courses in the sciences which might well be considered necessary to demand for the would be student in nursing.

The era of the *trained nurse* is drawing to a close. She will appear in the near future only in the history of the rise and fall of the apprenticeship system, but if history presents a faithful portrait she will be found there as an outstanding example of the value of a close relation between the student and the practice field. Despite many opinions to the contrary a proper division of the three years and a careful study and provision of the number of cases per student that will provide a sufficient body of experience in the branches determined to be essential will make possible

the inclusion of all the important services in the nurse's experience not however to the extent of preparing her for specialization. But the inclusion of these services will necessitate the requirement of courses in certain sciences already obtainable in high schools before admission to the school of nursing and the elimination of household duties the required experience in which could also be provided through a pre-vocational course.

What shall be deemed the essential branches must be determined by a study of the need of the community, not by the branches found in any given institution.

A survey of the hospitals maintaining schools of nursing of any state presents the majority dealing mainly with surgery and with an ever increasing private patients service. It also presents a number of special hospitals giving two or three years in their specialty. Because two thirds of the service of an institution is surgical is no reason two thirds of the student's time should be given to that service.

The author recommends that an investigation should be conducted of all training schools with the following result:

a. A direct knowledge of the wide variations in curricula and practical work.

b. Definite knowledge of cost of education and saving to hospitals by utilization of pupil nurses.

c. Practical program for changes in present method of education including:

1. Separation of school from hospital, graduates of school having choice of hospitals according to merit at graduation.

2. Relief of nurses from maids' work in hospitals which would improve the character of the hospital nursing.

3. Teaching of pupils by graduates paid for the purpose.

4. Shortening of hours of labor for nurses in hospital.

5. Raising the standard of nursing at training more students of a better class.

6. Diminishing the number of schools by amalgamating many existing ones.

7. Diminishing cost of instruction by such consolidation.

8. Improving physical condition of nurses.

III. WAYS AND MEANS TOWARD ACTION

MR ASA S. BACON, on behalf of the American Hospital Association presented a paper in which he outlined in the form of a questionnaire certain hospital data as the basis for standardization. This questionnaire reviled in the light of the discussion which followed its presentation and later by the General Hospital Committee will be printed by the College as a separate pamphlet.

FATHER C. J. MOULNIEP, On Behalf of the Catholic Hospital Association stated:

You are endeavoring to standardize hospitals. But hospitals are only one phase of the whole subject involved. You will never standardize hospital unity and systematize them except by unifying and systematizing the art of medicine, the healing art. To systematize, standardize, unify and make cooperative an art is a rather new thing in life. Art by its very nature is individual. It partakes of personal impulse and thought and imagination and yet in an art like medicine the healing art, the art that aims to do for the human race what it most needs — prevent, alleviate, cure, die a — is unquestionably something that must be standardized in the sense of being unified, systematized. We can think alike about physics, chemistry and mechanics because the laws here are fixed and definite. We can think alike in regard to some of the fundamental laws of biology because they are settled but to think alike as to how to apply that great complex of law called the science of medicine to the prevention, alleviation and cure of disease is a great big task which will in its final accomplishment reach away into the distant year.

There will never be an effective systematization, unification or standardization of hospitals until the public begins to think and the doctors think in broad outline and until the public begins to think and the doctor think, the full personnel of hospital will not think that is effectively. In order to make all think alike, the people must be told clearly and concisely that so much must be done in order to make this small or this great hospital what it should be.

This education must reach into the nursing

school into the sisterhoods into the high schools and colleges because naturally all of them are interested in this advancing movement and all feel the truth and the force that is back of the truth.

DR E. P. LYON, 'On Behalf of Medical School' states that the medical school has four primary interests in hospitals from the standpoint of teaching: (1) for the training of nurses, (2) for the training of undergraduate medical students, (3) for the training of internes and (4) for the training of graduate students or specialists. Beside these there is the interest of research which is as much a function of a university as teaching. Finally there is the interest which the medical school as a quasi-public institution and standardizing agency should have in medical practice as a whole.

Hospital standardization like medical school standardization is primarily even 90 per cent a problem of the staff.

If the staffs of hospitals accepted seriously their educational responsibilities the fifth or interne year could be made a universal requirement for the M.D. degree.

The first and fundamental change required before hospital can be standardized is a recognition on the part of the staff of their educational responsibilities.

The medical school interested in education and research cannot look upon the laboratory as accessory and secondary. It must be coordinate with the other department. It must have equal quarters, equal equipment, equally trained men in charge. The interne as a student (not as a servant) must have access to laboratory facilities. He should do the standard routine laboratory work on his cases all the time.

What should be the relation of the interne to the patients? From the medical school standpoint the patient is the material the student studies. If you shut up the patient in a private room and tell the interne to keep out, you are turning that interne out of school. Even in private hospital it is possible to give interns access to all of the cases. The tactful staff man has no difficulty in doing this. Only the self-conscious incompetent will object when he recognizes his teaching.

obligation to the interne. The medical school cannot approve an internship for fifth year credit in a hospital where any other condition prevails.

From the standpoint of the medical school a good autopsy service is indispensable.

The hospital should have an up to date library. Every hospital should also have working arrangements with a medical school

library or some other great collection by which books can be had on loan.

Hospital records are the basis alike of good teaching of all research founded on numbers and averages — the statistical method — and finally of the best work for the individual patient. The clinical just as the laboratory scientist must stand or fall on the written evidence of his work.

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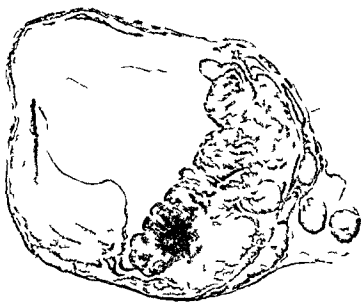
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EXCISION OF VESICAL DIVERTICULA AFTER INTRAVESICAL INVAGINATION BY SUCTION A NEW METHOD

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IN an exhaustive study of the literature of vesical diverticula in 1906 (1) I collected five cases in which the diverticulum had been radically excised which were as follows. In 1895 Plan (2) removed a diverticulum from the bladder in a girl of 13. Czerny (3) removed a large diverticulum by suprapubic excision, transplanted the ureter and subsequently had to perform nephrectomy on account of pyonephrosis. Riedel (4) after prostatectomy excised a large diverticulum extravasically; the patient died of collapse on the following day. Pagenstecher's (5) patient was a young man with a very large diverticulum containing the ureter. After suprapubic extravasical excision and transplantation of ureter the patient developed suprapubic and sacral fistula. Von Eiselsberg (6) excised a small diverticulum at the vertex of the bladder; patient presumably recovered.

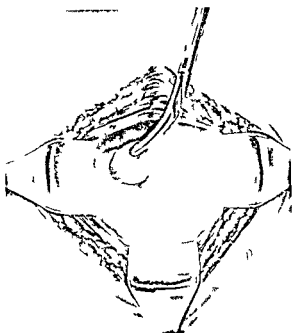
To these five cases I was able to add three as follows. Extravesical excision of large diverticulum with plastic procedure to bring back the ureteral orifice to the bladder. Intravesical excision of small diverticulum. Excision of small diverticulum at the vertex of the bladder extravasically. Extravesical excision of large diverticulum of the anterior wall of the bladder.

The eight cases mentioned above were all that were to be found in the literature at that

time. Since then there have been numerous publications among which may be mentioned articles by Chute (7), Calbot (8), Lerche (9), Lower (10) and Thomas (11). Lerche describes the extravasical extraperitoneal excision of a diverticulum which he had distended by means of a rubber bag introduced on the tip of a ureteral catheter. He gives brief summaries of 3 cases of diverticula (collected from the literature) which were treated by operative measures and includes an extensive bibliography. Lower's paper in 1914 presented a new method which consisted of packing the diverticulum with gauze through the bladder followed by extravasical excision of the diverticulum. Lower reported three cases in which this method had been employed. In one of them after the diverticulum had been excised it was found that the ureter had been divided and required transplantation. In another of these cases Lower employed the intravesical method of removal by invagination which had been first proposed and carried out by the writer in 1906.

In 1909 I reported the intravesical excision of a diverticulum which projected intraperitoneally and which contained a carcinoma (1).

The patient, a man aged 41, was admitted February 3, 1909, complaining of hematuria of three months' duration. No frequency or other urinary



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In recent year I have been more and more
struck with the importance of intravesical

removal whenever possible particularly in
the intraperitoneal and retrovesical or sub
trigonal types. I have either an intraperitoneal
operation avoided or the operation sim
plified because the extravesical removal of
diverticuli situated at or near the ureteral
orifice (especially those in which there has
been considerable suppuration with scar
tissue often involving rectum seminal ves
icle ureter and deep pelvic structures)
is not only very difficult but is apt to be
accompanied by injury of the above named
structures

The first intravesical method which I
employed was as follows. After dilatation
of the diverticular orifice a circular incision
was made through the mucous membrane
around the opening the diverticular mucous
membrane being grasped with hæmorrhoidal
forceps gradually drawn outward and ex
cised. In some cases it was possible to gra
p the diverticulum with forceps invaginate it
either by traction upon the forceps or with
a finger outside of the bladder assisted in
the invagination and after it had been
turned inside out within the bladder to
complete its excision. In large and very

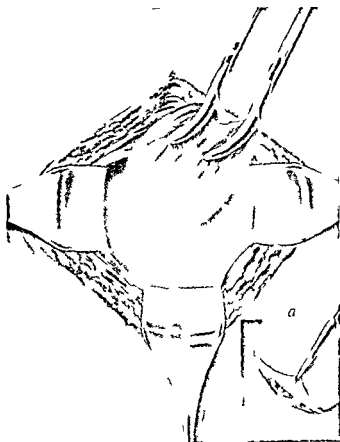


Fig 3 The intra vesical delivery of the diverticulum has been completed by the use of the clamp making traction at various points around the circumference. Insert shows circular incision around neck of diverticulum and beginning elevation of the mucosa.

deep seated adherent cases however neither of these methods was found suitable and I therefore adopted the following technique.

Invagination of diverticulum by suction and traction intravesical invagination of the sac of mucosa thus entirely avoiding sharp dissection and pushing the ureter (if present) back into the bladder intravesical closure extravesical drainage of region of diverticulum plastic operation punch or prostatectomy to cure obstructive cause of diverticulum.

This method is so well shown in the accompanying illustrations that hardly any further description is necessary. The diverticular orifice is investigated and if necessary dilated with forceps. Into this orifice a glass tube is inserted to the full depth of the diverticulum and immediate action with an electric air pump is commenced. It is usually evident almost at once that the mucous membrane has been drawn against the



Fig 4 A circular incision has been made through the mucosa at the neck of the diverticulum the mucosa elevated at one point and blunt dissection begun to peel out the lining membrane of the diverticulum.

orifice and the tube is then drawn very slowly outward a small distance the suction being continued until the mucous membrane of the diverticulum is seen coming upward inside of



Fig 5 The entire mucous lining of the diverticulum has been pulled up against the neck of the diverticulum and then divided.

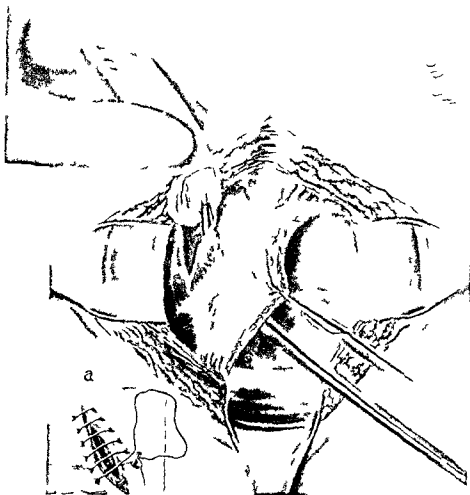


Fig. 6. The diverticulum is turned inside out within the bladder. A circular incision is made through the mucous membrane around the neck of the diverticulum and the mucous membrane elevated at one point (Insert a Fig. 3). Then by blunt dissection it is a simple matter to peel away and remove in one piece the entire lining membrane of the diverticular sac, the excised tissue consisting merely of mucosa and submucosa. Figures 11 and 12 actual size photographs show the excised sacs of mucosa and submucosa distended with cotton. In separating the sac and peeling it out (Fig. 4 and 5) the operator directs with gauze on the finger

the glass tube (Fig. 1). Not infrequently the mucous membrane reaches a point 1 to inches above the bottom of the tube. The glass tube is then slowly drawn out bringing the diverticular mucosa with it and as soon as the end of the tube is outside of the diverticular orifice the mucous membrane is caught with a toothed clamp (Fig. 2) and the glass tube then removed. The intravaginal delivery of the diverticulum is then completed by traction the operator using sharp toothed clamps applied at various points around the circumference and then possibly further dilating the diverticular orifice. In case the sac is very large and difficulty is experienced in delivering the whole diverticulum

through the small orifice (Fig. 3). As soon as the entire diverticulum has been turned inside out within the bladder a circular incision is made through the mucous membrane around the neck of the diverticulum and the mucous membrane elevated at one point (Insert a Fig. 3). Then by blunt dissection it is a simple matter to peel away and remove in one piece the entire lining membrane of the diverticular sac, the excised tissue consisting merely of mucosa and submucosa. Figures 11 and 12 actual size photographs show the excised sacs of mucosa and submucosa distended with cotton. In separating the sac and peeling it out (Fig. 4 and 5) the operator directs with gauze on the finger

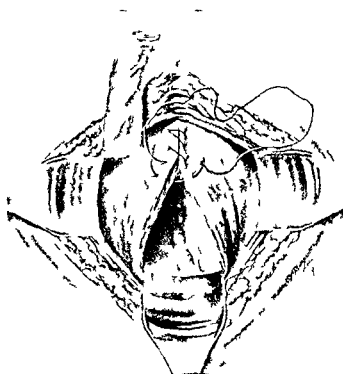


Fig. 7. After placing extravascular drain in midline incision in bladder closed with continuous suture.

pushing down all underlying structures thus avoiding hemorrhage and eliminating the danger of injury to the ureter. If the ureter comes into view it is pushed back only the thin membrane being removed. As shown in Fig. 9 it was necessary to push back the ureter in case 7 (No. 5682). The method of extravascular drainage is shown in Figs. 6 and 7. A cigarette drain is carried down extravascularly and lateral to the bladder until it reaches the collapsed cavity from which the diverticulum has been removed and the orifice of the diverticulum in the bladder is then closed as shown in insert *a* Fig. 6. The drawing shows a curved clamp passing into the bladder through the diverticular orifice into the cavity from which the diverticulum has been removed and out again laterally and extravascularly pulling the cigarette drain in place. The bladder incision is then closed around a rubber drainage tube or closed tightly leaving a retention catheter in place.

CASES OPERATED UPON BY THE INTRAVESICAL SUCTION EXCISEMENT METHOD

CASE 1. Diverticulum of the posterior wall (intraperitoneal) drawn into the bladder by suction



Fig. 8. Case No. 60. Six diverticula lying posterior to the trigone (one after another) were sucked into the bladder stripped of their mucous linings and closed. *a* Diverticulum being drawn up into tube. *b* Diverticulum released by tube and caught by clamp. *c* Diverticular orifice closed.



Fig. 9. Case No. 5682. The left ureter is clearly shown in the diverticulum. After incision in the diverticulum the bladder is drawn up into the tube. *a* Diverticulum being drawn up into tube. *b* Diverticulum released by tube and caught by clamp. *c* Diverticular orifice closed.



Fig. 1. S. H. M. T. D. G. H. L. F.
inc. t. l. ic. l. th. d. t. l. m.

and clamps intravascularly. O. uture f. a. cure.

No 50. W. B. E. age 47. The patient had had previous prostatic hypertrophy and perineal prostatectomy, the relief of obstruction and all the result for a time followed late by cystitis, frequent urination, residual urine. Examination showed on the left lateral wall the orifices of four small culles and on the right lateral the seral culles. Two or three centimeters external and posterior to the right ureteral orifice a fairly large diverticulum was visible. The prostatic orifice had a rounded lobule anteriorly. Residual urine 240 cubic centimeters. Bladder capacity 300 cubic centimeters. Operation April 13, 1914. It occurred to me to use suction through a glass tube to draw the lithium in de out within the bladder and this as accordingly carried out with really spectacular results. A large tube was introduced and erythrolytic action was applied the pale mucous membrane of the diverticulum as seen mounting through the tube. This continued until it had been drawn fully into the tube and a half inch in the tube which was slowly drawn out and the mucous membrane caught with forceps the diverticulum delivered and excised the opening being closed tightly entering the peritoneal cavity. The suprapubic wound was drained and the patient made an excellent recovery and had a splendid ultimate result.

CASE 2. Removal of six diverticula into avascularly by action method. Wound closed by suture. Excellent result.

No 260. J. C. M. age 9. Six years previously patient had had a perineal operation which was quite successful in removing obstruction to urination but recently there had been a return of the frequency and pain. Examination showed a prostate about normal in size, 60 cubic centimeter residual, small regular lobules hanging from the roof of the internal prostatic orifice, a markedly trabeculated bladder and the orifices of six small diverticula back of the trigone. Suprapubic cystostomy May 22, 1916. Excision of six diverticula which were found across the posterior wall of the bladder from

to centimeters distant from the posterior limit of the trigone. The incision was directed along a glass tube as large as possible as introduced into the diverticulum after another action applied the diverticulum from the bladder incision made around its neck mucous membrane stripped up and excised and the wound closed. These diverticula varied from 4 to 5 centimeters in depth and though adherent to the evaginated without much difficulty. A small anterior prostatic lobule was excised with scissors. Examination of the specimen showed that the perineal operation had been quite complete. Relieving of obstruction. Suprapubic drainage. Excellent condition. Report three months later condition excellent—patient voiding as much as 14 ounces at a time six times during the day and twice at night—till some pain and slight spasm in the posterior.

CASE 3. Suprapubic lithotomy. A. L. F. four live. Lateral incision. N. 5133. W. D. H. age 1. Patient had elevated blood pressure. Admission a lithotomy incision by perineal approach. Interval between lithotomy and perineal lithotomy. Examination showed frequency of urination till perineal lithotomy. Examination showed a slightly enlarged prostate residual urine 400 cubic centimeters bladder capacity 600 cubic centimeters. The cystoscopic showed moderately enlarged internal bladder a diverticulum in the left half of the bladder a small diverticulum on the right lateral wall and on the anterior wall. Numerous small culles and tubercles. Operation May 26, 1916. Suprapubic lithotomy. Excision of six diverticula. Perineal lithotomy. The use of the vacuum pump and the lithotomy. The lithotomy was removed but the diverticuli were deep and the same size as the diverticuli. The mucosa of the diverticuli was removed. The diverticuli were 2 to 3 centimeters in length the thick wall of the diverticuli. The diverticuli were closed by sutures, suprapubic drainage provided and the perineal lithotomy excised.

C. A. L. E. N. S. V. J. A. T. A. R. V. D. M. mediat. re. l. g. d. D. l. r. g. e. l. th. th. ty. furth. dy. iding. f. ely. ond. ti. n. cell. t. all. v. and. l. al. e. l.

Examination. N. m. b. e. 96. m. th. s. after operation. Condition excellent. Residual urine bladder capacity 300 cubic centimeters. Cystogram normal. No diverticula slightly tubular structure but subsided easily passed.

CASE 4. Suprapubic lithotomy. A. L. F. e. n. c. u. l. e. t. o. m. y. c. u.

No 520. D. G. B. age 58. s. admitted. A. g. st. 196. c. m. p. l. a. n. i. n. g. o. p. a. n. f. u. l. i. a. t. o. n. 18. 35. c. s. r. s. du. a. t. o. n. Examination showed the prostate about normal in size, residual urine 500 cubic centimeters bladder capacity 350 cubic centimeters. The cystoscope showed a slightly rounded median bar to small calculi, the bladder

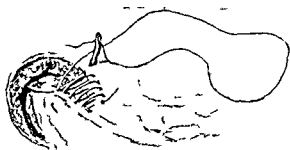


FIG. 10. Diverticulum (Drainage extravesical)



FIG. 11. Diverticulum (Drainage extravesical)

der and considerable mucus. No diverticula seen. Operation August 23, 1916. Suprapubic lithotomy. Intravesical diverticulectomy. Three calculi were removed. Diverticulum with orifice 1.5 centimeters in diameter was seen lying on the right posterolateral wall 1.5 centimeters above and to the outside of the right ureter. Suction was applied, diverticulum evaginated, drawn partly into the bladder with forceps and dissection begun. The deep portion had to be freed by dissection intravesically. Punch operation was done to remove prostatic bar, three cuts, one posterior and two lateral. Examination then showed a well dilated prostatic orifice. Suprapubic drainage provided.

Convalescence fairly satisfactory. Discharged in 5 weeks, voiding freely at intervals of 1 hour, considering himself well but still having 5 cubic centimeters residual urine.

CASE 5. Suprapubic intravesical excision of diverticulum.

No. 5481. E. S. boy, age 10, admitted October 10, 1916, complaining of pus in urine which had been present for 8 years. Marked frequency of urination, stream small, no pain or hemorrhage. Examination. The prostate and seminal vesicles scarcely palpable, urine cloudy with pus, no residual urine. Bladder capacity, 60 cubic centimeters. Cystoscopy. Just external to the left ureter was seen the orifice of a large diverticulum.

Operation November 8, 1916. Suprapubic intravesical diverticulectomy. Diverticular orifice was about 1 centimeter in diameter and external and somewhat posterior to the left ureteral orifice. It was drawn into the bladder by suction and clamp and proved to be about the size of a large hen's egg (Fig. 1). The neck was circumcised and the mucous membrane stripped off the intravesical wound closed and the site of the diverticulum drained extravesically. Before closing the bladder the trigone, which was quite prominent, was divided with scissors and sutured on each side. Nothing was done to the prostatic orifice which was normal. Convalescence was satisfactory. The patient was

discharged in six weeks in excellent condition, the wound well healed.

CASE 6. Median bar obstruction with diverticulum of the bladder, punch operation, diverticulectomy.

No. 4085. K. E. K., age 4. There was history of hesitancy and difficulty of urination since childhood and particularly marked obstruction for four years. Two years ago was catheterized and 1500 cubic centimeters urine obtained after that complete retention and catheter life. The cystoscope showed a markedly enlarged trigone with elevated edges. Ureters functioning normally. There was a large pouch behind the elevated ligamentum interuretericum. On the right lateral wall of the bladder was a diverticulum about 2 centimeters distant from the ureteral orifice. On the left lateral wall of the bladder at a point 3 centimeters external and in front of the ureteral was the orifice of another diverticulum. A third diverticulum with a large orifice was seen behind and external to the left ureter. Median portion of the prostate was elevated in the shape of a pronounced median bar.

November 4, 1914. Punch operation, four cuts, one anterior, one posterior and two lateral. Convalescence. Catheter removed in 36 hours. Patient discharged on the eighth day, voiding freely, good stream. Subsequent examination showed some residual urine, varying from 70 to 400 cubic centimeters. Subsequent cystoscopy showed the diverticula and the hypertrophied elevated trigone.

Operation November 1, 1916. Fricision of two diverticuli intravesically, punch operation through the suprapubic incision to remove the prostatic obstruction. The large diverticulum was evaginated by suction and clamps, a circular incision made around the neck and the mucous membrane stripped up with a sponge and excised. The two small diverticuli were removed in the same way after dilatation of their orifices. The prostatic orifice was found to be tight and fibrous and was enlarged by three cuts with the punch instrument. Suprapubic drainage. Convalescence was very satisfactory. Patient discharged in 3 1/2 weeks.

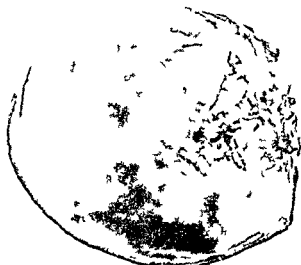


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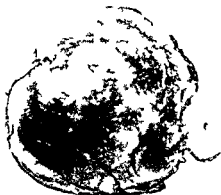


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PREMATURE SEPARATION OF THE NORMALLY IMPLANTED PLACENTA¹

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AMONG the causes of interpartum hemorrhage at full term or nearly so premature separation of the placenta occupies a place scarcely second in importance to placenta previa for it is no less frequent than placenta previa and may require equally radical treatment. Of course radical treatment is not always necessary. Sometimes a simple procedure as rupturing the membranes is sufficient to insure normal delivery and a satisfactory convalescence for the mother. On the other hand occasionally after the uterus has been emptied of the fetus and placenta the mother collapses and dies in shock without further loss of blood. Anticipating such an outcome in cases evidently serious from the character of the initial symptoms cesarean section has lately been employed and radical treatment has been justified by the pathological lesions disclosed at operation. Williams has treated two cases in this way and collected twenty others from the literature.

In these cases the uterus presented a remarkable picture: its color was bluish black from the extravasation of blood into its substance and it resembled somewhat an ovarian cyst with twisted pedicle. Following delivery the uterus did not retract but remained flaccid and hysterectomy was necessary to control hemorrhage. This abnormal reaction as histological study demonstrated depended upon the disorganization of the myometrium which was infiltrated with blood and lymph. Two cases of this type were recently treated in this clinic by abdominal cesarean section and supravaginal hysterectomy. As there was no clinical evidence to indicate the cause of the intramural lesion a series of experiments was performed and a technique developed which reproduced in animals the lesions which have been described in women suffering from the more serious type of premature separation of the placenta.

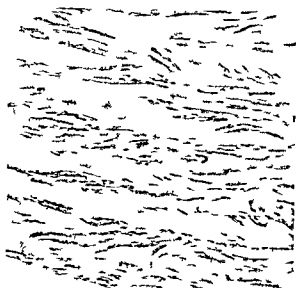
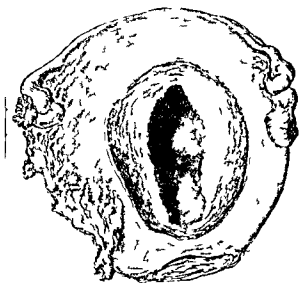
The clinical and pathological notes upon the two patients I have observed follow.

CASE 1. A. H. VIII para 30 years of age. Old child 18 years of age youngest 15 months. Previous history unimportant except for two miscarriages at the second month 17 and 8 years ago respectively. No history of any menstrual disorder last period September 15, 1915. Present pregnancy normal except for slight nausea and constipation until 10 a.m. May 10, 1916 when the patient then in the eighth month was seized with cramplike pains which half an hour later became more severe and continuous. Upon admission to the hospital at 5 p.m. she was pallid restless and complained of intense abdominal pain, pulse 80, temperature 98.6 and respirations 20. On palpation the uterus was enlarged, bregma below xiphoid tense and firm. The position of the fetus could not be determined nor could fetal heart sounds be heard. The external os was closed and there was neither vaginal discharge nor bleeding. In the absence of external bleeding the history together with the ligneous consistency of the uterus led to the diagnosis of premature separation of the placenta with concealed hemorrhage. Abdominal cesarean section seemed the most conservative method of delivery.

Upon opening the peritoneal cavity a small quantity of serous fluid escaped. The uterus was firm and bluish black in color, blood was extravasated beneath the peritoneum covering the uterus particularly about the upper portions of the attachment of the broad ligaments. The tubes and ovaries were free from hemorrhage. The uterus was packed off and opened by an anterior longitudinal incision through which gushed about 500 cubic centimeters of fluid and clotted blood. The fetus was found dead and the placenta completely detached. The uterus remained flabby in spite of cubic centimeters of pituitrin and vigorous massage and bled freely. Consequently supravaginal hysterectomy was performed.

Convalescence wasafebrile and otherwise uneventful. The patient was discharged on the twenty-first day in good condition. The urine specific gravity 102 contained no more than a very light trace of albumin at any time and casts were never found.

Pathological report. The uterus measured 13 centimeters from the point of implantation to the fundus 13 centimeter in width and 8 centimeters from the anterior to the posterior surface. The wall had a uniform thickness of approximately 5 centimeters. The entire external surface was



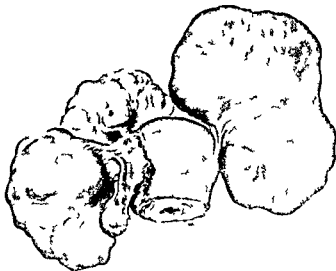


FIG. 3. Uterus with multiple pedunculated myomata. The darker tumor, the color of which resembles blood, is that of the uterus in Fig. 1, had a twisted pedicle.



FIG. 4. Myoma with twisted pedicle after hysterectomy. The cut surface of the tumor resembles a cross section of the myometrium in cases of premature separation of the placenta.

with a quantity of blood clots behind it. Supravaginal hysterectomy was performed.

On the second day after operation the patient died of bronchopneumonia. Autopsy showed bronchopneumonia, acute fibrinous pleuritis, pulmonary oedema, general anasarca, and parenchymatous nephritis.

Pathological report. The excised uterus had a bluish color and showed hemorrhagic effusions each approximately 5 centimeters in diameter about the upper portions of the broad ligaments. The tubes and ovaries were normal. Sections through the uterus showed extravasations of blood similar to those described in Case 1.

The placenta measured 21x14x1.5 centimeters and weighed 50 grams. An infarcted area on the maternal surface measured 14x1 centimeters. At some points this was 0.5 centimeter in depth; at others it involved the entire thickness of the organ. Outside the infarcted area the villi were normal. The decidua tissue adherent to the maternal surface contained numerous lines of fibrinous degeneration. There were no inflammatory changes.

Microscopic sections from the uterus showed the hemorrhage most intense in the outer half of the wall. In this region the muscle bundles were separated by extravasations of blood, but the oedema and disorganization of the musculature were less than in Case 1. The mural veins were engorged and there was diapedesis into the muscles. The smaller arteries were almost uniformly empty and presented endarteritic changes, not different from those ordinarily found in the uterus of multiparous women. Sections through the placental site showed the decidua engorged but without leucocytic infiltration. The venous sinuses were distended but there was no thrombosis.

Pathological diagnosis. Premature separation of a normally implanted placenta with external and

concealed hemorrhage. Hemorrhage into the uterine musculature, increase in the subepithelial connective tissue of the arteries.

To explain premature separation of the placenta a number of hypotheses have been advanced. Trauma or traction upon a short umbilical cord occasionally causes the detachment, but generally the explanation is not so simple and therefore the complication has been attributed to a lesion at the placental site or to a toxemia of pregnancy. For example, some authorities hold that an inflammatory or degenerative change in the decidua is the responsible factor; others emphasize the presence of hemorrhage into the myometrium or of thrombi in the intervillous spaces and decidua sinuses. Perhaps the most widely accepted theory explains the premature detachment as secondary to nephritis.

However, no hypothetical explanation has proved entirely satisfactory, for none is applicable to all the cases. Degenerative and inflammatory lesions of the placental site may be found or not; they were absent in the two cases just reported. And similarly, albuminuria and other symptoms of toxemia of pregnancy are inconsistent. The fact is that the cause underlying premature separation of the normally implanted placenta remains unknown.

In beginning the experimental study of this

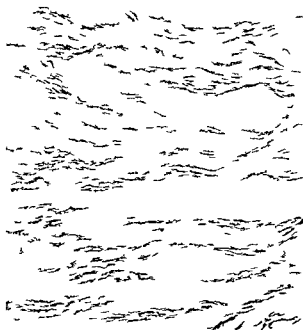


Fig. 4. Histological section of the tumor showing intense hemorrhagic infiltration and edema in many areas dissociation of the muscle fibers. The larger veins were empty but the smaller ones were engorged with blood. Microscopically then the lesion in the tumor (Fig. 5) is identical with that in the myometrium of case of premature placental separation. And since the acute changes in the structure of the tumor were evidently caused by a disturbance in its circulation the question arose as to whether the corresponding lesion in the pregnant uterus might not also be due to a similar disturbance. Furthermore the absence of necrosis in the myometrium as well as the presence of venous engorgement suggested that blocking of the vein rather than of the arteries was the responsible factor in the acute pathological process.

problem our first thought was that the lesion in the myometrium might be caused by the acute distention of the uterus due to profuse hemorrhage. Accordingly the following experiment was performed upon a pregnant dog. Under ether anesthesia laparotomy was performed a cannula was inserted into the pregnant horn of the uterus and sterile salt solution forced into the viscus until it was on the point of bursting. The cannula tract was then ligated and with some difficulty the abdomen was closed for the distention of the uterus interfered with the approximation of the edges of the abdominal incision.

No ill effect followed this operation the next day the animal appeared to be well. Forty-eight hours after the operation when the abdomen was again opened abortion was found to have taken place. The previously distended horn was entirely normal and without sign of injury. Therefore while in a sense the result was negative this experiment plainly taught that even an extreme and acute increase in intra uterine pressure did not cause extravasation of blood into the myometrium and dissociation of the muscle fibers.

In other words simple distention does not explain the uterine lesions in cases of premature separation of the placenta.

Our interest in this problem was again stimulated a few weeks later when from the treatment of a gynecological patient we got a clue which led to further experimentation yielding results of a positive nature. The patient in question entered the hospital suffering from a symptom referable to a myomatous uterus. At the operation multiple pedunculated myomata were found (Fig. 3) and the superficial appearance of one of the tumor the pedicle of which was twisted bore a striking resemblance to the uterus represented in Fig. 1. When the tumor was bisected (Fig. 4) no areas of necrosis were found but hemorrhagic lesion like those just mentioned in the uterus were distributed throughout the myomatous tissue.

Histological sections from the tumor showed an intense hemorrhagic infiltration and edema and in many areas dissociation of the muscle fibers. The larger veins were empty but the smaller ones were engorged with blood. Microscopically then the lesion in the tumor (Fig. 5) is identical with that in the myometrium of case of premature placental separation. And since the acute changes in the structure of the tumor were evidently caused by a disturbance in its circulation the question arose as to whether the corresponding lesion in the pregnant uterus might not also be due to a similar disturbance. Furthermore the absence of necrosis in the myometrium as well as the presence of venous engorgement suggested that blocking of the vein rather than of the arteries was the responsible factor in the acute pathological process.

With this hint investigation was begun to determine what are the effects upon the pregnant uterus when the venous flow is blocked. In rabbits at various periods of pregnancy the vein leaving one of the two uterine horns was carefully dissected from the adjacent arteries and ligated. The vessels of the other horn were not disturbed and therefore in each animal we had at the same time both experiment and control.

The veins of the rabbit uterus belong to one

of three groups namely (1) the ovarian (2) the mesometric and (3) the uterovaginal. Consequently a thorough study of the problem required that several types of experiment should be performed. In the first case each of the three groups of veins alone was ligated and in the circumstances there followed a temporary cyanosis of the horn and light engorgement of the constricted vessels. However the circulation quickly readjusted itself and the pregnancy suffered no damage.

In the second type of experiment two of the above groups of veins were ligated. Thus in one animal the ovarian and the mesometric veins were tied in another the ovarian and the uterovaginal and in a third the mesometric and the uterovaginal vein. In all the cases the results were similar to those obtained when a single group of veins was tied. The collateral circulation that appeared was adequate to prevent serious damage to the pregnancy even when two of the three vein groups were thrown out of function.

The third type of experiment consisted in ligating all three groups and blocked completely the return of venous blood through the vessels leaving one horn of the uterus. This treatment was followed by very definite and positive results and the same phenomena were observed each time the experiment was repeated.

One after another as the veins were tied they became engorged with blood and finally the entire uterine horn was deeply cyanosed. It was distended and fluctuant at first but ultimately grew tense and firmly resisted pressure. After these initial observations the abdomen was closed but was reopened in from

to 4 hours unless meanwhile the animal had died. At the end of this time in surviving animals the untreated horn was found to be normal whereas the affected horn was a deep purple in color was enlarged about twice its former size and was quiescent muscular contractions having ceased. When incised the uterine cavity was found filled with blood which surrounded the unruptured foetal sacs the placenta were partially or completely separated from their attachment and minute extravasations of blood were visible in the myometrium. Hemorrhage and

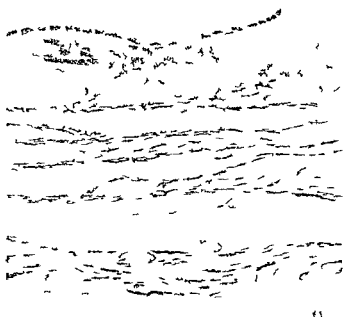


Fig. 1. Cross section of uterine wall from the pregnant animal after experimental ligation of the uterine and ovarian veins.

hock apparently were the cause of death in the animal which did not survive the experimental ligation of the veins.

Microscopic sections from a number of zones in the distended uterine horn demonstrated that the mesometric veins, the decidua sinuses and the intervillous spaces were engorged with blood. Hemorrhagic extravasations also were common in the decidua. At various points the uterine wall presented similar extravasations as well as dissociation of the muscle fibers. Blood clots intervened between the placenta and its attachment to the uterine wall. Obviously these are the same lesions as those found in women suffering from this complication of pregnancy.

The experimental reproduction of premature separation of the placenta then has been accomplished by ligating the veins which conduct the blood from one side of the bicornuate uterus and the minute resemblance between the experimental lesion and those due to natural causes indicates the existence of identical etiological factors in both cases. What blocks the veins in human pregnancy occasionally is still a matter of speculation but the autopsy findings in two cases which have been put on record bear directly upon this problem. Thrombosis of both ovarian veins has been described by Young in a case of premature

placental separation and in this instance there were also hæmorrhagic lesions in the myometrium. Blocking of the veins by thrombi however has not been mentioned in the reports of other case and therefore broad significance cannot be ascribed to this etiological factor.

Of more importance however are the findings in a case recorded by Gliniski. His patient a woman far advanced in her ninth pregnancy was suddenly seized with severe abdominal pain and died before surgical treatment could be attempted. At autopsy the uterus deeply cyanotic and with a relatively long cervix was found rotated out of its normal position 2/0 to the right. The uterine cavity contained fluid and clotted blood the attachment of the placenta was partially broken the myometrium was purple and there was venous engorgement of a notable degree. In this instance the circulatory disturbance obviously depended upon a mechanical factor which in all probability has a wide application for the complication in question is predominant in multiparous women with relaxation of the abdominal wall.

Inadequate support on account of tonic structures or of a distance between them clearly permits greater mobility of the pregnant uterus and consequently there is opportunity for an unusual degree of torsion or for the assumption of other unfavorable positions. In these circumstances stretching or kinking of the blood vessels in the broad ligament may interfere with the circulation. Since the veins have thinner walls they would suffer constriction earlier and more completely than the arteries. This assumption furthermore has the support of the experimental results for the specific circulatory disturbance which caused orogenic lesions like these in women depended upon a constriction of the veins.

From the viewpoint of practice this demon-

stration of the underlying cause of premature separation of the placenta indicates that more attention should be paid to the nature of the support which the abdominal wall affords the pregnant uterus especially in the case of multiparous women. If there is relaxation of the abdominal wall and consequently excessive mobility of the uterus favoring torsion or movements of other kinds likely to interfere with the circulation the uterus should be supported and stabilized by a suitable abdominal binder. This precaution not unlikely will go far toward reducing the frequency of cases of premature placental separation.

CONCLUSIONS

Acute distention of the uterine cavity does not provoke the lesion of the myometrium associated with premature separation of the normally implanted placenta. The underlying cause of this complication is an obstruction to the circulation of blood through the uterus. When this is provoked artificially in pregnant rabbits by ligating the veins of one horn of the bicornuate uterus the resulting pathological lesion duplicate those found in women suffering from this complication of pregnancy. The untreated horn remains normal. Probably in excessive mobility of the human uterus predisposes to a similar though spontaneous constriction of the veins in the broad ligament of women advanced in pregnancy and consequently closer attention should be given to the degree of support the abdominal wall affords the uterus especially in multiparous women.

OBSERVATIONS ON WAR WOUNDS OF THE KNEE-JOINT AMONG
FRENCH SOLDIERS

BY J. R. JUDD, M.D., F.A.C.S., HONOLULU, HAWAII

THE following paper is based on personal experience among French wounded extending over a year combined with observations of ideas and methods practiced by French surgeons. The last word in knee joint war surgery has by no means been said and this contribution does not attempt to exhaust this important subject. The observations are presented with the hope that they may be of value not only from a military standpoint but that deductions may be made which will be useful in surgery of civil life.

INTRODUCTION

Since the beginning of the war ideas as to treatment of wounds of the knee joint may be said to have passed through three stages. The first stage was that of conservatism. The first aid dressing was applied the wounded man was evacuated to the rear and was received with a suppurative arthritis for which he was treated by arthrotomy with the well known bad results. The second period was the period of radicalism. Better equipment at the front permitted radical surgery to be undertaken. Immediate resection was advised and performed. Limbs and lives were saved but the fear of suppurative arthritis caused many excision of bone and resulting mutilation. In the third period of today the improvement of surgical equipment and experience permits a more rational and conservative line of treatment.

Wounds of the knee joint in this war occupy the same importance that has existed for this class of wounds throughout the history of surgery. Wounds of this articulation exhibit the same gravity that they do in civil life but owing to the better resisting powers of the patient the result obtained are probably better in war surgery provided the patient receives early treatment. The resisting powers of a soldier are far superior to that of the average civil patient. The early exclusion of walking and discarded the

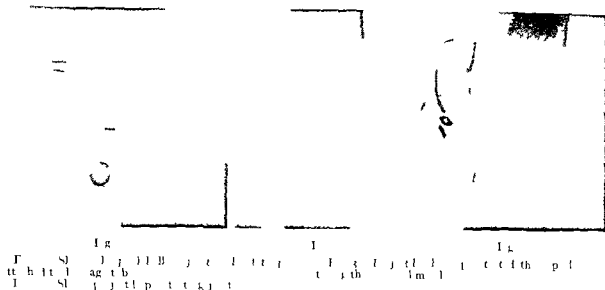
months of open air life with absence of dissipation result in the average soldier in the trenches being able to stand traumatism in a remarkable manner. To counterbalance these factors must be considered the often dirty condition of the soldier's skin and clothing and the length of time that must elapse between the receipt of injury and the institution of proper treatment.

The gravity of knee wounds has been considered as due to rapid absorptive powers of the extensive joint synovium. But the early changes of infection transform the synovium into a suppurating membrane which early loses its synovial quality and powers of absorption. More probably the most important factor in the gravity of knee infection is the complex structure of the joint which allows the secretions to accumulate and prevents drainage. This is illustrated by the fact that often the worst cases are those in which the joint has been wounded through a small opening whereas when the joint has been opened by a large wound allowing free drainage the progress of the case is more favorable.

The synovium possesses a real power of defense which varies considerably in individuals. There are a certain number of cases even when the projectile is included that comport themselves aseptically. Duval has noted that the joint fluid was sterile a number of hours after receipt of injury although the projectile present gave a positive culture. He suggests the possibility of a free interval in wounds of the knee during which time the joint rests aseptic although harboring a septic foreign body.

The ankylosing tendencies of individuals varies likewise as the powers of synovial resistance. There are those who do not ankylose readily, those who ankylose early and rapidly and those who ankylose slowly and insidiously. Chiput has noted the following:

1. Tuberculous cases never ankylose by immobilization of sound joint.



Ordinary subjects only ankylose because of infection or hemiarthrosis long immobilized.

3. A small minority ankylose rapidly and early even when the articulations are sound. A contusion of the wrist followed by ankylosis of finger and elbow illustrate this type. To this class of cases he gave the name of ankylophiles.

Mauchaire reports a case of infection of the knee drained for one month by a large tube traversing the joint under the patella. Recovery resulted with two third movement of the joint.

The following note illustrates the joint tolerance that may be met with.

A Algerian soldier, 21 years of age, was brought to the front two lateral incisions made and drainage tube placed. The effusion was removed through the joint beneath the patella. After a few days during which time he was treated by massage and under constant air drainage for sixteen hours he arrived at the hospital. A drainage tube showed the ball as seen in figure. The temperature was normal, the tube was removed and the arthritis only wounds all visible. The joint had some fluid present but there was no point in temperature. On October 26, the swelling had subsided, the ball was removed through a incision on the outer side of the patella. There was no union. November 3, a drainage tube was inserted and allowed to drain. He was discharged November 13 with perfect use of the joint.

CURRENT

The knee joint is more frequently wounded than any other joint of the body. According to Delorme knee joint wound comprised one third of all joint wound and 3 per cent of all wound. Leriche states that two thirds if not more of thigh amputation that he has seen at retiring board have been due to lesions of the knee.

Of a total of 13 wounded received by Depage 14 were knee joint lesions. It is noticeable that injuries of the knee involving fracture of the patella are more common since the introduction of grenade and bombs used at close range in trench warfare.

MORTALITY

A comparison of the mortality of the great war with other wars is interesting. Chenu's figure from the Franco-Prussian War gave a mortality of 93 per cent in 10 cases. As late as 1878 Alhurst wrote in his *Principles and Practice of Surgery* "The rule should be regarded as imperative that every gunshot fracture of the knee joint is a case for amputation." According to Borden the mortality in the Civil War was 33.7 per cent. Franco-Prussian War 48.9 per cent. Japanese-Chinese War 25 per cent. Spanish-American War 5 per cent. Boer War 4.2 per cent.

Statistics of the French army have not been officially published and information on

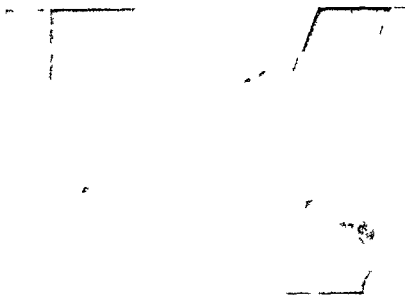


Fig. 4 (at left) Projectile partly in joint laceration synovial membrane
Perforation of femur by bullet just above upper margin of patella

is subject must be gained from reports of individual surgeons. Duval places the mortality of 58 cases of suppurative arthritis of the knee at 7 per cent. Martin reports 26 per cent mortality in a series of 30 cases. Schwartz and Mocquot report 11 cases with 2 deaths and Monod reports 144 cases with 9 deaths. Four of these succumbing at once on account of multiple wounds. Rouvillois from an automobile ambulance reports in 197 cases of knee joint wounds a mortality of 17 per cent later reduced by improved methods of treatment to 6 per cent. Crebore has recently reported the remarkable success of 52 cases of knee joint wounds with and without bony involvement with only one death. It is certain that the heavy mortality of the earlier months of the war has been materially reduced.

CLASSIFICATION AND VARIETIES

Wounds of the knee joint may be simply classified as follows:

- I. Wounds without bony lesions
- II. Wounds with bony lesions
 1. Wounds without bony lesions are caused usually by bullets or shrapnel balls less often by a piece of shell bomb or grenade and rarely by a bayonet. A rare case that came to my notice was one in which a soldier suffered from a penetrating wound of the knee

joint caused by a piece of his comrade's skull being driven into his knee by a shell explosion. The articulation may be traversed by the projectile without touching any bone. The shoulder is the only other joint where this is anatomically possible. Joints so wounded show the dictation of hemiarthrosis and bloody synovial fluid discharges from the orifices. The projectile may penetrate into the joint and remain there or the skin and capsule may be penetrated and a small contusion or laceration of the synovial membrane be caused with resulting effusion into the joint.

The articular area may show a wound of entrance but no wound of exit. Whether the joint itself is involved must be determined. Inspection of the wound will often determine this or the characteristic discharge of bloody synovial fluid. The X-ray examination is most useful and important. An intra-articular projectile usually causes infection but infection may be escaped. A small foreign body that has not been noticed may cause a slow form of chronic arthritis called *pseudo tumor albus* which has been recognized by many surgeons. The clinical features of white swelling appear slowly after several weeks. There is swelling of the joint thickening of the tissues with slight amount of fluid present. Muscular atrophy

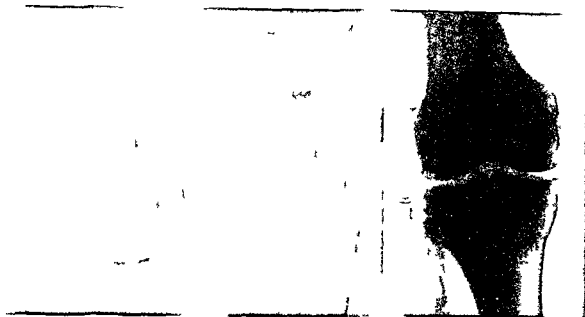


Fig 6

Fig 6 Bllt df tu fl lffm
Bllt g j t ftb t f t l k t
g l t f t d l p d 3 d y ft y

Fig 7

Fig 7 I s I t f t b l th k d t r
t d g t j t lt f t f k 4 d
ft pt f l y

Fig 8

appears early and ankylosis always results even if the foreign body is removed

II Wounds of the knee with bony lesions
These may be classified according to the degree of the injury as follows

1 Wounds by rifle ball traversing the bone
The small wounds of entrance and exit are present the reaction is slight and the outcome favorable

2 Wounds with limited epiphyseal lesions
In these cases there are separation and division of the cartilages fissures of the epiphysis fractures with or without displacement The wounds are caused by a bullet which has ricocheted pieces of shell or grenade and are nearly always infected Sometimes they may show a subacute form going on to ankylosis

Lesions of the epiphysis accompanied by slight fissures penetrating the articulation are important because they are often overlooked The joint does not show reaction at first and the examination of the X ray plate does not reveal any fissure extending to the articular surface The first symptoms that

may be noted are sudden rise of temperature pain and swelling of the joint In any case where the fracture is near the joint an involvement of the articulation should be suspected X ray plates should be taken in different positions When the fissure extends into the joint the articulation is almost sure to become infected

A typical case illustrating the gravity of fracture with fissure extending into the joint is here recorded

A soldier wounded July 6 by piece of shell admitted to the hospital July 10th infected commencing from the tibia There was no apparent involvement of the joint X ray findings are shown in Fig 67 The wound opened up July 14 treated by tube drainage and irrigation P ossibly able until July 4 when the wound became infected accompanied by pain and swelling of the knee Arthromyositis followed on the same day a quantity of thin pus was evacuated Tube drainage and irrigation The temperature became normal August 4 an infection resulted in ankylosis

A resume of a second case is as follows

A soldier was wounded July 6 by grenade He entered the hospital July 10 with a compound



Fig 9

Fig 9. Wound with extensive bony lesion illustrated by ankylosis.

Fig 10. Fracture in olecranon articulation filled with infection of ankle joint, 5 days later.

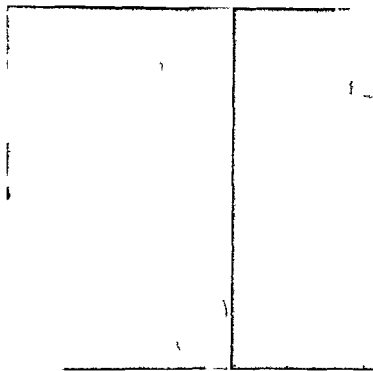


Fig 11

Fig 11. Suppurative arthritis of knee which was followed by infection of the ankle joint, 8 days after receipt of injury.

fracture of the upper end of the tibia with involvement of the external popliteal nerve. Examination and X-ray findings (Fig 8) showed apparently no involvement of the knee joint. On July 30 suddenly symptoms of joint infection appeared. Arthrotomy was followed by a favorable progress to ankylosis.

3. *Wounds with extensive bony lesions and comminution.* These wounds are caused by bullets fired at close range or by shell. The lesions of the soft parts are more or less extensive and there is comminution of the epiphyses with free bony fragments in the soft part or in the joint cavity. Fissures may extend along the diaphysis and into the medullary cavity. The destruction of bone varies in degree to pulverization of the epiphysis into a bony mass. Damage to the main blood vessels and nerves is encountered. These cases are of extreme gravity and the sequel is usually loss of life or limb or extensive loss of bone.

The classification may also be made according to the bone affected. The fracture may be limited to the patella or to the tibia or femur or to any combination of the three

bones. Makins has described a condition which he calls vibration synovitis. The occurrence of considerable synovial effusion into the joints of limbs in which the articulation was primarily untouched. They were apparently the direct result of vibratory concussion of the entire limb dependent on the blow received by the bullet. This condition is not recognized by the French surgeons as far as my observation goes.

COMPLICATIONS

The complications are primary and secondary hemorrhage, nerve injury and infections.

Severe or fatal hemorrhage may result from injury of the main blood vessels by the projectile or by bony spicules. Secondary hemorrhage from ulceration of the arteries may occur. This is usually an open bleeding and limited to smaller blood vessels. It may occur in the course of an artery surrounded by muscles as was seen in one case where the posterior tibial artery became involved in a periarthritic suppuration with resulting



FIG. 1. (Left) Patient with hematoma of the knee joint. (Right) Patient with hematoma of the ankle joint.

ulceration and extensive intramuscular hemorrhage.

On account of the proximity of the sciatic nerve lesions of this nerve would be expected to be frequent but they are surprisingly uncommon.

Infection and septicemia are common especially in cases not treated early. Gangrene is sometime encountered. Metastatic infection of the ankle joint of the same leg sometimes occurs and the presence of pain in the ankle should lead to an immediate investigation. A suppurative process in the ankle joint is a severe addition to the strain on the patient's resisting powers and often decides the question of amputation. This formidable complication may occur in the later stages of a suppurative arthritis of the knee when the patient is apparently doing well.

This complication is illustrated by notes of two cases.

A soldier was wounded July 18 by a bullet. The result was a fracture of the upper part of the tibia and the joint. The patient was admitted to the hospital July 18. He was treated by continuous irrigation. On July 18 a symptom of infection of the ankle joint appeared. This was treated by multiple aspirations of the ankle joint. The patient was discharged July 25.

The second case was remarkable for the length of time that elapsed before the involvement of the ankle developed.

A soldier was wounded July 18 by a bullet. He was treated by continuous irrigation. On April 6 after the discharge from the hospital he was found to have a large abscess of the ankle joint. The patient was admitted to the hospital April 6. He was treated by continuous irrigation. On April 6 the patient was discharged from the hospital. He was found to have a large abscess of the ankle joint. The patient was admitted to the hospital April 6. He was treated by continuous irrigation. On April 6 the patient was discharged from the hospital. He was found to have a large abscess of the ankle joint.

DIAGNOSIS

The location of the wound, the character of bloody fluid and the effusion into the synovial cavity are important points in diagnosis. In case of doubt as to whether the fluid present is due to a hemarthrosis or an infection of the synovia an exploratory puncture may be made with a Luor or Pravaz syringe and the fluid examined. A leucocyte count is of value.

The symptom of pain, swelling and rise of temperature are not conclusive of infection. An injured knee is always painful. There is spontaneous pain and pain on active and passive motion. Swelling may be absent because the extent of the wound allows the fluid to drain off as fast as it accumulates. The swelling may be due to synovial fluid, blood or pus. Fever is almost always present even an elevation of 2 to 4 degrees when no suppuration develops.

Radio copy discloses metallic foreign bodies, their number, size and situation and



Fig. 14

Fig. 14 Arthrotomy by median incision, hitting the anterior cruciate ligament and patella

Fig. 15 Complete removal of the patella



Fig. 15

Fig. 16 Shortening of 12 centimeters following hemiarthrotomy

Fig. 16

with practice the surgeon can decide whether or not they are in the synovial cavity. But foreign bodies non-metallic such as pieces of cloth are not shown. Also certain lesions as injuries of the articular cartilages, menisci, fissures and partial fractures without displacement. Radiography is superior to roentgen copy as metallic foreign bodies are shown more exactly and partial fractures and fissures. The roentgenograph should be taken both in the anteroposterior and lateral aspects.

TREATMENT

One of the difficulties in arriving at conclusions as to the best method of treatment is that individual surgeons seldom have the opportunity to follow a case throughout its clinical course. For this reason great differences of opinion and some confusion have existed as to the value of different procedures. The surgeon at the rear receives the wounded several days after they have been operated on at the front and his acquaintance with the original conditions may cause disapproval of the measures undertaken. The cases which are rapidly fatal and the lesions of the amputated cases are not seen at the rear. Those cases that arrive there are those that are able to withstand the journey. The type received represent the lesion of

limited severity and from this develops the idea of the comparative benignity of knee infections.

Leriche says: No rational plan of joint surgery in war can be formulated unless the exact locality where one operates is indicated in considering intervention. A line of treatment appearing conservative at the rear is insufficient at the front and a conservative operation at the front appears too radical at the rear. Leriche gives the following interesting data. Among 115 wounded 908 were sent back from the extreme front and 307 or about one fourth were held in the zone of combat for immediate intervention. Of the 908 who were judged evicuable none left the zone of the army until the evening of the day after they were wounded and then after passing further examination which resulted in retaining a large number on account of the aggravation of their wounds. Of the 307 wounded retained in the zone of combat for immediate intervention one third presented articular lesions.

Out of the mass of divergent views as to the proper treatment of these joint injuries emerges a fundamental principle agreed to by all. This principle rules all war surgery and is early intervention with removal of the infection, projectile and other foreign bodies



FIGURE 12. A patient in bed, possibly demonstrating a condition related to the text.

As to the extent of primary intervention individual views vary considerably but the early conservatism followed by reactionary radicalism involving the sacrifice of too much bone has been succeeded by a rational scientific and efficient line of treatment.

1. Removal of foreign bodies. All intra-articular foreign bodies should be removed without delay. This is not only on account of infection but in order to preserve the function of a joint harboring a projectile cannot functionate properly. A projectile buried in an epiphysis should be removed if infection is present. When it is embedded in the bone and there is no splintering or infection it may be well tolerated and may be left *in situ*. If later on it gives rise to trouble it may be removed secondarily when its removal would not endanger the risk of infecting the joint. Figure 12 illustrates a case of this nature where the projectile was well tolerated and did not interfere with the functions of the joint.

Treatment of hemiarthrosis without bony lesions or foreign bodies. This class of cases

is best treated by evacuating the contents by puncture, compression and immobilization. Where there are slight bony lesions caused by a ball which has completely traversed the joint the same treatment should be employed. The injection of 1 per cent formalin glycerine solution has been used but is not generally employed.

3. Treatment of patella injuries. Loose fragments should be removed as much subperiosteally as possible. If there is a fair prospect of aseptic healing large fragments may be brought together by a catgut periosteal suture. In cases of extensive comminution the entire patella may be removed subperiosteally, closing off the synovial membrane as well as possible. The loss of the patella provided the healing of the wound progresses favorably does not necessarily prevent a good functional result.

4. Arthrotomy versus resection. It is in the decision as to the best treatment of wounds with bony lesions that there has existed the greatest divergence of individual opinion.

Marion laid down the rule that it is permissible to remove articular fragments completely detached but it is forbidden to excise bony fragments or to do typical resections. On the other hand Iericke teaches

A fracture destroying the joint stability ought to be treated by immediate resection because at this time the operation early removes the source of infection and later it safeguards the future function of the knee. This course alone guarantees a good equilibrium of the limb, a fundamental condition for future use.

Cottrell says: For bony lesions penetrating beyond the depths of the cartilage or the cortex of the bone and when it is impossible to exclude the synovium primary resection causes less risk to the patient and permit him to recover in the best condition. Arthrotomy should be limited to wounds of the synovium in order for removal of the projectile.

Depage says: We practice arthrotomy and install the Carrel method when the bony lesions are not too extensive. If in the contrary the lesions are serious we resort at once

Those holding the more radical views claim that

1 Arthrotomy should be considered an exploratory procedure and a procedure for extraction of the projectile

Removal of bony splinters and pieces of cartilage should follow arthrotomy in cases where there is a minimum bony lesion

3 Primary resection is indicated if there is a fracture of the epiphyseal border if a fragment is detached or there are bony splinters to any marked degree. A subperiosteal resection should be employed with preservation of the periosteum capsule and tendinous insertions

4 Removal of fragments may give good results but it is only in exceptional cases and under favorable circumstances

5 Resection is necessary in order to remove the source of infection provide proper drainage and to ensure a good orthopedic result

6 Bad results from primary resection are attributed to improper methods of performing the operation

The more conservative argue that removal of the splinters and fragments is the more conservative procedure and that resection is unnecessary and too mutilating

In the secondary stages when the wounded are received in a febrile condition

1 Arthrotomy is applicable to simple synovial lesions for removal of the foreign bodies and for providing drainage and for arthritic suppurations kept up by a superficial bony lesion

2 Resection is necessary when there is fracture and infection and should be performed at once. This removes the focus of infection which is more osteomyelitic than articular. For suppurative arthritis without bony lesions resection is useless

Indicating the proportion of cases in which resection was deemed necessary. Rouvillois reported 197 cases of wounds of the knee in which only 11 or 5.5 per cent were resected primarily

5 *Methods of arthrotomy* The classical arthrotomy by incisions on each side of the patella have been modified in various ways



FIG. 18. Plaster of Paris splint with metal bridge used after resection

1 By a horse shoe incision dividing the ligamentum patellae and laying back a flap in which the patella is included

2 The arthrotomy of Ollier. This comprises in addition to two lateral incisions one on each side of the patella two posterolateral incisions anterior to the hamstring tendons. Drains are passed between the two incisions on the same side. A fifth incision through the popliteal space may be added

3 Chaput recommends removal of the patella

4 Fieux opens the cul de sac by a crucial incision and turns back the corners of the flap and holds them in place by sutures

5 Delbet has suggested complete section of the lateral ligaments which with continuous traction opens up the joint and allows drainage

6 Jaboulay splits the cul de sac and elevates the limb to an angle of 45 degrees

7 At the Julliy hospital of the American Ambulance the following method was practiced with satisfactory results. The patella ligament and cul de sac were divided in the median line from the tibial tubercle to the upper limits of the cul de sac. Lateral accessory incisions were made and drainage tubes inserted on each side. The two halves of the patella were held apart by short pieces of wire. The thigh and lower leg were then encased in plaster of Paris the knee area bridged over by metal bands or meshes of

I g o N n s m ti tt l ct
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wire the ends of which were incorporated in the circular plaster splints above and below the knee. The patient was kept on his abdomen a good part of the 4 hours and by this dependent position and the wide incision free drainage was maintained. The two halves of the patella were allowed to come together as improvement progressed and finally healed solidly. The result was a firm ankylosis with out impairment of the quadriceps.

Drainage of the joint by laying open the articulation by a curved incision and maintaining the limb in a flexed position as recommended by Leck and other has not come under my observation. Perhaps the difficulty of transportation with the limb in the flexed position have prevented this method from being employed.

The use of rubber tube traversing the joint is not generally approved. They act as foreign bodies and adhesion rapidly form about them. The tubes also readily become blocked with fibrinous membrane which prevents drainage.

Sometimes drainage is placed through the popliteal space but there is danger of secondary hemorrhage and this procedure is not recommended. Incisions in this region should be restricted to search for a projectile and not for drainage.

In the after treatment the gutter splint or plaster of Paris with metal bridges across the joint are used. The Blake splint is easily

to apply very comfortable and by its use the parts can be kept clean in a satisfactory manner as the limb is suspended.

For irrigation of the joint various solutions are used. Saline solution, peroxide of hydrogen, formaldehyde, carbolic, sublimate, chloride of magnesium 12:1:1000 and Dakin's solution. These solutions are used intermittently or continuously. With increasing experience Dakin's solution is becoming more and more favored. Chloride of magnesium has many partisans.

6. *Method of resection.* The incision usually employed is the curved horseshoe incision or the H shaped incision. The joint is opened the clot evacuated and the periosteum stripped back. The patella is considered more harmful than useful and is usually removed preserving as much of the periosteum as possible. The synovial membrane is dissected out with forceps and scissors. The bony section is then made with the saw. The section may cross some fissure but no trouble from them need be apprehended. The femur and tibia may be held together by metallic suture but these are not necessary. Drainage is provided and the quadriceps tendon and capsule carefully sutured.

Immobilization is secured by a posterior plaster gutter splint extending from the groin and including the foot. A posterior wooden splint with a foot piece may be employed. If a plaster cast with bridge of metal is used a small posterior splint must be added to maintain the bony position and prevent posterior displacement of the tibia.

The classical resection is generally recommended. In order to preserve as much of the length of the limb as possible in cases where the lesion is limited to the femur the section of the tibia may be limited to the removal of the layer of cartilage to a depth of a centimeter and barely touching the bony tissue. Some attempts at partial resection have been made but the orthopedic results are usually poor. A removal of one condyle causes subsequent deviation of the limb. Hemiresection is not regarded favorably. The apposition of a raw bony surface to an intact cartilage produces ankylosis only when the cartilage has disappeared as a result of in-

flammation. In cases of destruction of the lower extremity of the femur and the end of the bone projects as a point this point has been successfully implanted into a niche hollowed out of the tibial surface. In rare cases where the condyle of one side and the tuberosity of the opposite side are comminuted the *resection en escalier* is indicated.

The procedure of keeping apart the bones by extension in order to create a cavity is considered a mistake. The raw bony surfaces bathed in pus offer a surface for septic absorption the spongy tissue becomes infected and if septicæmia is escaped union is compromised.

Bad results occur when the bony surfaces have not been kept in good apposition and improper alignment has resulted when the operation has not been done subperiosteally and non union results when the extent of the femur removed makes union impossible when the operation is done too late or for too extensive lesions and amputation is indicated.

Many surgeons testify to the beneficial effects of heliotherapy. The rays of the sun act as a stimulant to the tissues. Embryonal blood vessels form rapidly the wound assumes a healthier appearance and there is a favorable flow of lymph. Heliotherapy is especially valuable in joint wounds. The patient is carried out of doors every day when the sun is shining and the wound exposed to the rays of the sun for a varying period. The practice of exposure of wounds to the sun was employed in the days of Julius Caesar's conquest of Gaul.

7 *Indications for amputation.* Primary amputation is indicated when the bony lesions are so extensive that resection is impossible or dangerous. When the injury involves the main blood vessels when the presence of multiple wounds and the general condition show that the patient must be relieved of the focus of infection amputation must be performed to save life. At times when there is an enormous number of wounded and proper postoperative care is impossible amputation is indicated.

Secondary amputation is indicated when arthrotomy or resection has failed to arrest

the progress of infection. This septic condition manifests itself by the bad general condition of the patient elevation of temperature with regular oscillations albuminuria septic vomiting or diarrhœa. Local manifestations of an unfavorable character are œdema of the ankle of the sound leg pitting on pressure of the affected thigh abscess formation in the thigh secondary hæmorrhages metastatic infection of the ankle joint or a rapid involvement of the entire limb by a gas gangrene or mixed infection.

THE NEW ERA OF KNEE JOINT SURGERY

Dissatisfaction with past results and the evolution of the idea that it is of vital importance to perform at once the operation applicable to the case have brought about an improved and rational method of treatment of knee wounds in the early stages. To Loubat is generally credited the origin of the technique. Duval calls the method the laparotomy of the knee. The operation should be carried out as soon as feasible after receipt of injury as follows:

- 1 The knee joint is widely opened by a U shaped incision dividing the ligamentum patellæ.
- 2 The blood clots are evacuated and the synovial cavity is flushed out with ether.
- 3 The projectiles loose cartilaginous and bony fragments are removed and the bony cavities curetted.
- 4 The margins of the perforations of the synovia are excised and then sutured with catgut.
- 5 The joint is completely closed with out drainage by a two layer suture.
- 6 The edges of the wounds of entrance and exit are excised down to the synovia and then sutured.

This method is to be used only for wounds of the joint with or without intra articular fracture and is not intended for cases with extensive bony lesions demanding resection or amputation. Duval is convinced that for articular injuries treated in this way early drainage will become exceptional and that primary resection will be limited to cases of extensive injury where no conservatism is possible.

The bacteriological examinations made by Faucher showed that the projectile was always infected. The bony tissue in contact with the projectile always showed infection present but after curettage the pieces of bone picked up were sterile. The synovial membrane around the projectile and surrounding the perforation always showed infection. The articular fluid was sterile 8 times out of 11. In 3 cases the bacillus perfringens was found. The joint fluid has been found sterile 24 hours after injury although harboring a septic foreign body. This suggests to Duval a free interval in which the joint rests aseptic.

This method has been employed to a considerable extent at the front by French surgeons and has been subjected to modifications.

Alquier has suggested that instead of closing the joint tightly which involves a certain amount of risk, an arthrotomy be provided. One or two stomata are made at the center of the cul de sac or laterally. Most commonly a single stoma is made at the outer side by suturing the synovia back to the skin after a short cross cut has been made at the upper end of the arthrotomy incision. On the fourth or fifth day if the wound is aseptic the sutures may be removed and the flap stitched back into place.

The lateral incision may be employed when there is doubt as to whether the wound is penetrating or not and when the X ray examination shows that the projectile and bony lesion are superficial. The lateral incision may be transformed into the U incision if one encounters any difficulty in extracting the foreign body or in excision of the damaged tissues. Sencert summarizes the indications as follows. If the X ray examination shows that a projectile exists in the joint laterally at the end of the trajectory make a lateral incision retract the wound edges and remove the projectile. Excision of the margins of the wound caused by the projectile and suture complete the intervention. If however the X ray examination shows several projectiles situated in the joint or laterally at the side opposite the orifice of entrance then the U arthrotomy permits a complete exposure of the joint and a removal of the projectiles etc.

In cases where it is decided not to suture the joint at once and the articulation is left partly or entirely open compresses are placed beneath the patella. These compresses are wet with sterilized horse serum antitetanic or antidiphtheritic serum or the serum of Leclainche and Vallee.

The time of secondary closure depends on the temperature and the appearance of the wound. Usually the time to suture lies between the second and eighth day. The secondary suture is often followed by a rise of temperature for one or two days.

Following the laparotomy of the knee a fenestrated plaster of Paris splint is applied or a metallic gutter splint is used.

Between the fifteenth and twentieth day, sometimes earlier, the apparatus is removed. Mobilization is commenced the same day or a day or two afterward. The incision should be completely healed and fever, swelling, spontaneous pain and pain on pressure should be absent. For regaining the function of the joint the co-operation of the patient is essential. He should be instructed to make active contraction of the quadriceps at first without movement followed by attempts to raise the leg in the extended position off the bed. Later on he should make slight flexion at the knee which he increases progressively. The next stage is for him to stand on his feet and to walk with a cane bending the knee. As improvement continues he walks up and down stairs and practices squatting with heels together. Passive movements should accompany active movements and should be gentle and painless. When pain is complained of movements should be stopped at once. Mechanotherapy is not considered essential. When practiced too early or by one who has an insufficient knowledge of the lesions and treatment employed it is apt to provoke pain and inflammatory reaction and instead of combating the joint stiffness increases it. Massage aids in rendering force and tone to the muscles.

Treatment of sinuses. The following methods are used to avoid sinus formation.

1. For small superficial cavities following curettage of a bony lesion the joint is closed without regarding them.

2 For a superficial cavity near a fold of synovia the cavity is isolated and made extra articular by suturing the synovium to the margins of the cavity

3 When the cavity is situated at the anterior aspect of the condyles or at the level of the trochlear surface the fatty portion of the ligamentum mucosum is fixed into the cavity by suture

4 For larger cavities located in the spongy tissue and surrounded in nearly all its extent by bone Delbet's paste may be used The composition is wax 50 gr chloroform 6 ccm tincture of iodine 6 ccm

Sinuses which have formed are treated by ordinary methods of curetting and Beck's paste Some surprising results have been obtained by the use of the serum of Leclunche and Vallee The serum is injected or a small gauze wick soaked in the serum is loosely packed into the sinus A local reaction results followed in some cases by the separation of a fragment of dead bone and a subsequent healing of the tract

Results Depage has made an interesting report of his results treated by three different methods In the first period that of arthrotomy drainage and irrigation the mortality was 13 per cent suppurations 68 per cent and restoration of movement 24 per cent In the second period by the use of Carrel's method the mortality was 3 per cent suppurations 28 per cent and restoration of movement 46 per cent In the third period treatment by the so called laparotomy the results were no mortality suppurations 4 per cent and restoration of movement 86 per cent Duval has employed this method in 19 cases with one failure Mocquot and Monod from a study of 68 cases which they have followed up report the following results 44 cases restoration of movement 15 cases partial or complete ankylosis 6 cases resection 3 cases amputation Rouvillois from an automobile ambulance makes a striking comparison The first 39 cases of knee joint lesions were treated by the earlier method of lateral arthrotomy removal of foreign bodies detached bone and cartilaginous fragments followed by curettage of the bony lesions the use of drainage tubes and irriga-

tions of various solutions The results were 17 per cent mortality numerous secondary interventions long delayed healing and ankylosis The second series of cases 138 in number were treated by the improved method with 6.2 per cent mortality

Objections to this method have arisen Tuffier reports that in some cases operated on and apparently in good condition there develops later on an atrophy of the quadriceps and a dry arthritis as shown by partial stiffness and weakness of the knee and creaking of the joint Leriche recommends that the knee laparotomy be not employed systematically as lateral arthrotomy is preferable when it is sufficient The U arthrotomy should be reserved for difficult or exploratory arthrotomies Gregoire does not favor division of the ligamentum patellae as motion on the eighth to tenth day cannot be obtained when this ligament has been divided In spite of the objections it is generally conceded that the new method gives better results than other methods that there is less mortality fewer amputations more movable joints and less hospitalization

SUMMARY

1 Wounds of the knee joint in modern warfare maintain the same importance and gravity that have existed since the birth of surgery

2 The resisting powers of the synovia and ankylosing tendencies vary in individuals

3 In the presence of an infected projectile and infected joint fluid the synovia may still be uninfected for a certain period

4 Fissures extending to the articular surface are important and are often unrecognized

5 Secondary infection of the ankle joint sometimes occurs unexpectedly and is a grave complication

6 The earlier methods of non interference drainage tubes and wholesale removal of bone have yielded disastrous results

7 The mortality has been greatly reduced by improved methods of treatment

8 Perforating wounds traversing the joint should be treated by puncture compression and immobilization

9 For wounds with foreign bodies included with or without bony lesions early intervention is the secret of success

10 The new era in knee joint surgery calls for arthrotomy within 48 hours removal of projectile foreign bodies and loose fragments excision of path of projectile cleansing of joint and suture without drainage

11 Extensive bony lesions demand primary resection

12 It is in the decision as to what cases should properly be treated by the new era method and what cases demand resection on account of the extent of the bony injury that difference of opinion between individual surgeons is bound to exist

13 From all points of view vital preservation of the limb and its function and duration of hospital stay the results of the improved method are vastly superior

REMARKS ON DICHLORAMINE-T¹

By EDWARD K. DUNHAM M.D. NEW YORK

DICHLORAMINE T one of the newer antiseptics is an aromatic chloramine containing a little over 29 per cent of chlorine. Its systematic name is toluenepara sulphondichloramine and it is closely related to chloramine T from which it differs in having two atoms of chlorine in the molecule instead of one and no sodium (See graphic formulæ). These differences are associated with differences in solubility. Dichloramine T is only very slightly soluble in water freely soluble in certain oils the reverse is true of chloramine T. This property of dichloramine T is of essential importance in its use as an antiseptic. For our understanding of chlorine antiseptics and their mode of use we are chiefly indebted to Dr H. D. Dakin.

The clinical application of dichloramine T in the treatment of wounds will be fully described by Dr Lee who in collaboration with Dr Sweet now in France has been a pioneer in developing the technique and who has at this time a larger experience in the use of this antiseptic than anyone else in this country.

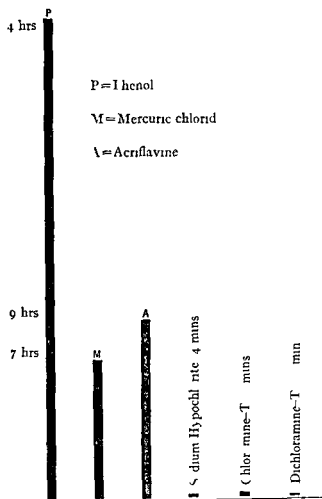
Although the topic assigned to me in this discussion is dichloramine T it does not seem possible to confine these remarks wholly to that substance. While its properties adapt it to a particular mode of use the principles involved in its action are those concerned in the activity of all members of the chlorine group of antiseptics and these

cannot be satisfactorily considered without reference to antiseptics in general. I must therefore beg you to accompany me in a brief survey of the whole subject of the antiseptic treatment of wounds from the laboratory viewpoint.

Bacteriological studies on antiseptics have shown that even when apparently perfect contact is attained all the bacteria present are not equally rapidly killed. Disinfection proceeds over a period of time during which the amount of disinfection at any given moment progressively diminishes. In this the phenomenon resembles simple chemical reactions between two substances in all of which time is a factor. The rate of disinfection varies with the nature of the disinfectant and the medium in which it acts. This will be illustrated by a few concrete examples farther on.

For successful disinfection three conditions must be met: first contact of antiseptic with infecting organisms; second time during which this contact is maintained; and third adequate mass or concentration of the antiseptic at the points of contact.

The matter of contact is of the utmost importance for no antiseptic acts at a distance. It can in consequence only serve as an adjunct to the surgical cleansing of those wounds in which the infected portions are not exposed to contact with the antiseptic application though some chlorine compounds used as antiseptics assist markedly

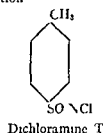
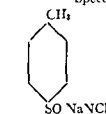


in the dissolution of necrotic tissue and have a cleansing action as will appear. But little dependence can be placed upon the power of penetration of any known antiseptic least of all when these are chemically unstable in the presence of substances occurring in wounds.

The questions of time and mass cannot be considered in such general terms. They depend upon the nature of the antiseptic and the conditions of its use.

There are three things of prime importance that should be known about an antiseptic before it is chosen as appropriate for a given purpose because the way in which it should be used to obtain the best results depends upon such knowledge: first the *speed* or rate of disinfection; second the *stability* of the substance under the conditions of its use since this affects the duration of disinfection; third the *permissible concentration* for this determined the *mass* of antiseptic that can advantageously be employed. I invite your

Speed of Disinfection



attention to a brief discussion of these three factors governing the surgeon's choice.

The *speed* of disinfection is enormously influenced by the medium in which the antiseptic acts. A solution of mercuric chloride for example may kill a given number of bacteria suspended in water within ten minutes and yet fail to sterilize completely in three hours a similar suspension in blood serum. It is not safe to assume that tests made in one medium can give exact information as to antiseptic potency in a different medium. The final test of surgical efficiency of an antiseptic must be the clinical experience in the actual treatment of wounds. The conditions in a wound cannot be completely reproduced elsewhere.

But even in identical media there is a wide divergence in the speed with which different antiseptics accomplish disinfection. A few experiments results of which are illustrated on this chart may be cited to show this. The medium used was selected to simulate in a convenient way the chemical character of wound secretions. It was a mixture of equal parts of blood serum and muscle extract. This was abundantly inoculated with staphylococcus aureus and solutions of various antiseptics in concentrations commonly employed were added in quantity constituting one third of the final volume. The rate of disinfection was followed by estimating the surviving organisms at definite intervals of time.

A 2 per cent solution of phenol failed to sterilize the mixture in 24 hours although the surviving organisms were only two per

thousand of those originally present Mercuric chloride (1:1000) accomplished the same degree of disinfection in three hours and completely sterilized in seven. Acriflavine a dye recently introduced as an antiseptic (3:1000) killed all the bacteria in about nine hours. In very sharp contrast to these antiseptics the members of the chlorine group were extremely rapid in action. Sodium hypochlorite (Dakin's solution) 0.5 per cent completely sterilized in 4 minutes. Eusol 0.27 per cent and chloramine T (1 per cent) in 5 minutes and dichloramine T (2 per cent in oil solution) in less than half a minute when well mixed with the septic material.

Turning to the question of *stability* there are numerous forms of instability manifested by antiseptics when applied to wounds such as decomposition, precipitation, adsorption, changes in electrolytic dissociation, etc. It would lead us far afield to consider them all. I shall confine myself to members of the chlorine group.

All the compounds of this group have a direct chlorinating and an indirect oxidizing power. In the presence of substances susceptible of chlorination or oxidation by them under the conditions present this power is brought into play with a corresponding decomposition of the antiseptic compound. The rapidity with which the antiseptic is used up depends upon the speed of these reactions and the relative masses of antiseptic and other reacting substances present at the moment. There are many substances in the secretions of wounds which call forth and participate in such reactions. The deodorizing effect of these antiseptics is evidence of one phase of this reactivity, but the changes wrought in proteins are the ones to which I wish particularly to draw attention for with these the germicidal action is associated.

Among other linkages in all protein molecules are certain aminogroups in which nitrogen is united to hydrogen. Compounds containing active chlorine (as do all the antiseptics of this group) part with that element in the presence of protein substances and this chlorine replaces the hydrogen in the amino radical, converting it into a chloramine. The change is illustrated on this chart. The

chlorine thus linked to nitrogen remains active and the protein chloramines possess marked antiseptic properties. If however as also happens the chlorination results in a linkage between carbon and chlorine the latter ceases to be active and the compound at least with respect to this portion has no antiseptic value. It must not be inferred that chlorine in the free state is at any time detectable during the foregoing reactions.

All proteins irrespective of their origin are susceptible to these changes including the toxins produced by infection. The chlorine antiseptics have a very striking detoxicating effect upon wounds in addition to germicidal and deodorant action. This is manifested by a fall in temperature in fever due to absorption when septic wounds are adequately treated with these substances.

From the foregoing statements it will be evident that the germicidal action of chlorine antiseptics is not specific but is incidental to the high reactivity of this group of compounds. It also becomes obvious that many substances are always present in a septic wound which destroy antiseptics of this class. We have already seen that these reactions take place with great rapidity.

The net conclusion is that for the best results which can only be expected when the antiseptic action is maintained until disinfection is complete, provision must be made for an adequately frequent renewal of the antiseptic. I need only refer at this time to the technique which has been developed to accomplish this result in the treatment of infected wounds with aqueous solutions of hypochlorites.

The third factor, namely the *permissible concentration* in which these antiseptics can be applied and therefore the mass entering into the above reactions, can only be determined by clinical experience. It is governed chiefly by the degree of irritation occasioned by the solutions employed, especially upon the skin and mucous membranes as these are more susceptible than the deeper tissues. With sodium hypochlorite always necessarily used in aqueous solution the limit is about one half of one per cent, with Eusol a

trifle more than half that strength. Clinical experience has shown that solutions of such strengths should be renewed at intervals of about two hours. It is not probable that any hypochlorite remains as such for more than a small fraction of that time. When the method of intermittent instillation is employed the result is a series of sharp but brief antiseptic shocks tapering off to nothing through the less rapid action of the protein chloramines formed in the early moments of maximum chlorination. Chloramine T is far less irritating than the hypochlorites and can be used in greater concentration. The chlorine is already linked to nitrogen which fact appears also to be a factor in prolonging the act of disinfection.

Dichloramine T occupies an exceptional position. It is so slightly soluble in water that aqueous solutions must necessarily be ineffective although the reactivity of the compound is extremely high. But solutions in oil can be used in great concentration up to 5 per cent if need be thus introducing an extraordinary mass of antiseptic at a single application. And this abundant and apparently excessive mass can become effective without undue irritation as the following considerations show.

When an oil solution of dichloramine T is

brought into contact with an aqueous medium a portion of the active chlorine passes from the oil into the latter and the amount so transferred depends upon the character of the substances contained in the aqueous medium particularly their ability to take up chlorine. Three experiments may be cited in illustration.

A 6.5 per cent solution of dichloramine T in eucalyptol¹ and paraffin oil was shaken with respectively equal volumes of normal saline of muscle extract and of blood serum. After standing for three hours the oil was completely separated and the active chlorine in the aqueous portion determined. The results expressed in terms of dichloramine T were 1.6000 in the saline, 1.300 in the muscle extract and in the serum which was mostly coagulated 1.111.

When proteins are present and they in variably are in the secretions of wounds the amount of active chlorine transferred from the oil solution is amply sufficient for rapid action. This is in harmony with the facts already presented. Moreover the action is continuous not intermittent and the renewal of antiseptic coming into play in the secretions is automatic and persists until the store in the oil has been exhausted.

S the red g f th p p t h b n f d pos bl t
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THE USE OF DICHLORAMINE-T IN THE TREATMENT OF INFECTIONS AND INFECTED WOUNDS¹

By LIEUTENANT WALTER E. LLL M. C. AND CAPTAIN WILLIAM P. FURNESS M. C. PHILADELPHIA

THE experience of nearly two and a half years at the Hospital of the American Ambulance in Paris has been in accord with that of the majority of surgeons who have served in the present war namely that the chlorine preparations have given uniformly better results than all other germicidal agents. It was soon found however that all of the standard hypochlorite preparations as *cau de Javal*, Labarraque and the esol solutions were very irritating to the skin if used for any length of time. In order to minimize this irritation various

modifications of the original formulæ were tried the most successful of which was that of Dakin, a very dilute neutral Labarraque solution. This neutral hypochlorite solution was found to have three inherent faults.

1. The neutral solution unlike the original Labarraque solution with its free alkali was very unstable and it was necessary to prepare it almost daily.

2. The dilute 0.48 per cent solution contained such a very small mass of germicide if the concentration was even slightly lowered e. g. to 0.4 per cent the germicidal efficiency

was so very materially impaired that it was necessary in order to obtain a maximum effect to have the solution at all times in contact with the surface of the wound

3 The active chlorine was used up so rapidly from the solution when it came in contact with the wound exudate from seven to fifteen minutes as estimated by Carrel that it was necessary frequently to renew the supply of germicide at least every two hours night and day

Carrel Dehelly and Depage gradually overcame all these inherent faults of the weak neutral hypochlorite solutions of Dakin and Daufresne by developing a beautiful but complicated technique for their application. And with this technique they were able to obtain wonderful results in the treatment of infected wounds

It is generally conceded that they have demonstrated conclusively —

1 That if infected wounds are treated with the same aseptic surgical care that surgeons give to clean wounds very unusual results can be obtained

2 That the primary dressing of infections and infected wounds should be made a formal aseptic operation in which all devitalized and infected tissue should be removed with knife forceps and scissors that it is mechanically practical and anatomically justifiable to sacrifice

3 That infected wounds so treated can be sterilized if the wound surfaces are constantly bathed with even such a small mass of germicide as is contained in the aqueous hypochlorite solutions. This constant immersion can be accomplished by Carrel's complicated hydraulic system of reservoirs and tubes

4 That when the wound surfaces are practically clean one bacterium per five microscopic fields on three successive days the wound edges may be approximated by sutures and union may be expected to take place without infection in almost 90 per cent of the cases

Many have had the privilege of seeing the work of Carrel and Depage and can personally testify to the accuracy of their claims but the indifferent success most of us have had in trying to obtain similar results Carrel himself says is because of our failure to grasp and apply the details of the technique. The Carrel technique demands an unusual degree of painstaking and time consuming care not peculiar skill upon the part of the surgeons nurses and chemist and the unusual expense

for both the apparatus and dressing material develop difficult problems for the entire personnel of even our civil hospitals. It is essential in this technique of Carrel so to prepare the wounds at the primary operation that they will act as basins for retaining the hypochlorite solution during the period of repair. Thus the cardinal principle of surgery dependent drainage of infected cavities must be abandoned if this treatment is to be used. In spite of this if the wounds are subsequently treated with the aqueous hypochlorites with the infinite care Carrel practices the results will be far better than with any other treatment we have used in the past. But if for any reason this perfect hydraulic system breaks down and it is very vulnerable wounds prepared in this way act as basins for pus and as has been expressed by many military and civil surgeons such wounds give unfortunate results

We must not forget in our admiration for the Carrel technique that it was because of the severe skin irritation produced by the standard hypochlorite preparations that Dakin first suggested his modified Labarraque solution and that because of the inherent faults of this Dakin solution instability the very small mass of germicide contained and the rapidity with which it liberated its chlorine it was necessary to develop an unusual technique to make such a solution effective in the treatment of infected wounds

Or this might be stated in another way that the Dakin solution and Carrel technique represent an effort to modify Labarraque's solution and the method of its application to infected wounds in such a way that there will be a minimum of the dreaded skin irritation produced by the original Labarraque formula

These facts were soon realized by Dakin and he started a new search for a more effective germicide if possible a chlorine compound which would be non toxic and non irritating to both the surface of the wound and to the skin and which could be placed in contact with the infection in a menstruum that would be capable of containing not only the desired mass of germicide but also of holding in solution a reserve mass over a long period of time

In these investigations he found that the various hypochlorite preparations used in the treatment of infected wounds react with proteins of any kind and one of the first reactions consists in the amido groups uniting with the active chlorine to form substances containing the NCL group.

These products which belong to the group of chloramines possess marked bactericidal properties and are probably the active germicides when they come in contact with the wound exudate. These chloramines are non irritating to animal cells and this explains the absence of irritation in the wounds where the irritating active chlorine of the hypochlorite has been changed into chloramines and other non irritating protein derivatives.

It is quite simple to produce many of these chloramines synthetically. The first one to be used was in the form of a sodium salt of tolueneparasulphonchloramide or chloramine T and sold in this country under the trade name of chlorazene. This synthetic chloramine was non irritating to the skin and could be used in aqueous solutions in 2 and 4 per cent strengths but it had the same fault as the aqueous hypochlorite in that its active chlorine was liberated very rapidly and though the difficulty of the skin irritation was obviated it was still necessary frequently to renew the solution as with the aqueous hypochlorites.

Dr Dakin entrusted to Dr Joshua A Sweet and the writer the honor of testing the surgical value of another synthetic chloramine at the Pennsylvania Hospital tolueneparasulphondichloramine which he called dichloramine T and which he had been using experimentally in the nasopharynx of meningococcal carriers. This preparation was first made for us by Dr Byron M Hendrix at the laboratories of the University of Pennsylvania. For the last six months Dr Paul A Lewis has made in his laboratories at the Henry Phipps Institute the large quantities required for this clinical test. Without this co operation Dr Lewis own work would have been impossible and we wish to take this opportunity of expressing our obligations. Dissolved in chlorinated

eucalyptol it could be used in strengths varying from 5 to 20 per cent. By using oil as a menstruum a large mass of germicide was brought to the infection and yet held so firmly in solution that it very slowly diffused into the surrounding medium for at least as long as eighteen to twenty four hours and during this period a mass of germicide was at all times active which was equal to that given off during the first seven to fifteen minutes by the hypochlorite solution.

Theoretically then this new chlorine compound eliminated at the start the chief indication or necessity for the Carrel technique skin irritation. With such a solution it should be possible to present to an infection an overwhelming mass of germicide a 20 per cent solution of dichloramine being approximately 80 times the germicidal mass of a 0.48 per cent hypochlorite solution. There is a vital necessity when using germicides in the treatment of infections for the earliest possible application of an overwhelming mass of a rapidly acting agent because infection develops in the tissues at the rate of geometric progression and not by the slow process of addition. Therefore every minute counts in the end result. Dichloramine with a phenol oil coefficient of about 50 can be presented in a larger mass without injury to the tissue cells than any other germicide we have used. Instead of exerting its germicidal power with explosive rapidity and the consequent necessity of frequently renewing the solution it would be slowly diffused into the surrounding media making it unnecessary to renew the solution or to dress the wounds more frequently than once in every twenty four hours.

Five months have elapsed since the writing of the first report upon the use of dichloramine T in the treatment of infections and infected wounds. We have now the records of 6028 civil cases in which the germicide has been used and of four months work and 100 cases reported by Capt Joshua Sweet with war wounds in the United States Base Hospital No 10 in France. From this clinical experience the conclusions tentatively offered in our first report have developed into firm convictions.

3311 cases are reported by Dr Robert I Cummins from the surgical dispensary of the Midvale Steel Works

2271 cases reported from the Pennsylvania Hospital from the surgical services of Dr Robert G LeConte, Francis T Stewart and Walter E Lee and of the work of Dr Robert C McIver

207 from the Germantown Hospital in the service of Dr Walter E Lee and the work of Dr Robert Kelly and Dr Robert Regester

60 cases from the St Agnes Hospital by Dr G M Do rance

50 cases from the Children's Hospital in the service of Dr Walter E Lee by Dr Edgar Christy

80 cases from the Jefferson Lankenau and Episcopal Hospitals

From the records of 33 cases at the Midvale Steel Works it has been possible to make a comparison between the efficiency of the nature of iodine and dichloramine T. A period of four and a half months in 1906 when iodine was exclusively used was compared with the same period of time in 1917 when dichloramine T was used. The results with dichloramine T were in all respects 60 per cent better than with iodine.

An interesting comparative study was made at the Pennsylvania Hospital between the Carrel technique and Dakin solution and dichloramine T applied with the technique to be demonstrated on the screen. With the working factors as nearly the same as it is possible to have them, namely surgical asepsis and the amputation of injured parts, a total of 157 industrial injuries were treated by the Carrel technique and the Dakin hypochlorite solution with an average healing time of 14.4 days. The succeeding three months of dichloramine T, the simplified technique was used in the treatment of

81 cases with an average healing time of 10.4 days.

At the Pennsylvania Hospital and Children's Hospitals there have been 528 cases under our direct personal supervision. In the 85 cases of infection there was but one case in which a localized process was not controlled and in which there was a secondary involvement of tendon, bone or joint. In this group there were 60 cases of bone infection and yet in no instance was it necessary to amputate because of infection. There is no doubt that the period required for healing has been considerably less than that with any other germicide we have used.

There has been a total of 165 lacerated and infected wounds. When mechanically possible we have routinely closed these wounds by suture up to six hours after the receipt of the injury and frequently as late as twelve hours and always without drainage. The wound surfaces have been covered with 20 per cent solution of the oil before the sutures were inserted. Over 75 per cent of these cases have healed without clinical signs of infection.

There have been 36 cases of extensive burns. The unusual comfort to the patient together with the simplicity of the dressing apparatus to the surgeon

The time required for healing has been decidedly less than obtained by any other means employed and the resulting scars are soft and pliable and very much better than obtained by us with amblyne.

With dichloramine T and the simple technique we have been able to obtain as good results as we have ever had when using the Dakin hypochlorite solutions with the complicated technique of Carrel. In addition we have found—

- 1 That skin irritation will not occur if the wounds are not covered with thick occlusive dressings. This means the use of the smallest possible amount of gauze dressing and bandage.

- 2 That the small amount of exudate from wounds treated with dichloramine makes it practical to use these thin dressings and in our dispensary at the Pennsylvania Hospital there has been a saving of 75 per cent of the gauze and bandage formerly used. Further a still greater saving in dressing material and time results from the decrease in the number of dressings required for each wound during the period of healing. Rarely is it necessary to dress a wound even during the first few days more frequently than once in every twenty-four hours and after that intervals of forty-eight and seventy-two hours are usual.

- 3 That dichloramine unlike the aqueous hypochlorite solution has no effect upon the knots of catgut ligatures and no disintegrating effect upon the catgut itself. The occurrence of secondary hemorrhages in wounds treated by the Carrel method was not uncommon in our experience at the American Ambulance. Captain Sweet reports that in his 1200 cases of major infected military wounds there was not a single secondary hemorrhage.

- 4 That too great stress cannot be laid upon the value of dichloramine as a deodorant dressing. The absence of the usual disagreeable odors in our wards containing cases with fecal fistulae has been a general observation. During the last two months it has been used routinely in the wards of the Oncological Hospital in Philadelphia. Where formerly these putrid sloughing malignant tissues were irrigated every two hours with all kinds of solutions with indifferent success in the

control of infection and with a persistence of the offensive odor now they are packed lightly every forty eight hours with gauze saturated with a 10 per cent solution of dichloramine T. Not only has the odor disappeared entirely but the wound infections have been controlled.

That there may be no misunderstanding of our position as to the value of germicides in the treatment of infections and infected wounds we wish to repeat the concluding statement of our first report:

'One should not depend upon a chemical

agent to perform in the treatment of suppurating wounds that which can and should be done quickly and thoroughly by mechanical means. Neither chemistry nor bacteriology can or should be expected to replace the mechanics of surgery. At the best, these chemical germicides can react only on the bacteria with which they come in contact, which means a very superficial process. Therefore at the primary operation all foci of infection and all devitalized tissue must be removed when possible by surgical procedures.

ASCENDING URINARY INFECTIONS¹

AN EXPERIMENTAL STUDY

By ALFRED C. DAVID, M.D., CHICAGO

SENATOR says: All that causes an inflammation of the lower part of the genito-urinary tract before all a cystitis has an etiological bearing on pyelitis and pyelonephritis.

The routes by which infection might travel in reaching the ureter and kidney from the bladder are: first, regurgitation of the bladder contents through the ureterovesical orifice, second, direct extension from the bladder through the wall of the ureter, third, extension of the infection by way of the bladder lymphatics to the ureteral and kidney lymphatics, and lastly, by way of the blood stream.

A brief review of the literature will give the evidence gained by clinical, anatomical, and experimental work bearing on these possible routes of infection.

In a general work on experimental infections of the urinary tract, Rovsing (1) and Melchior (2) conclude that (1) experimental cystitis could not be produced in animals without retention of the urine or trauma to the bladder, (2) With retention of urine experimentally produced pyelitis as a rule did not result, (3) Trauma to the bladder with or without retention of urine produced pyelitis and pyelonephritis.

In 1899 Zeit and Peterson (3) concluded after transplantation of the ureters in the intestinal tract in 141 dogs that infection of the kidney eventually took place. No effort was made to study the route of infection.

Guyon and Albarran (4) in 1890 injected charcoal into the bladder of dogs ligated the urethra and found charcoal in the pelvis of the kidney in 48 hours. They noted pyelitis and pyelonephritis in some of these animals.

Lewin (5) and Lewin and Goldschmidt (6) in 1893 working with rabbits injected milk or air into the bladder with moderate intravesical tension and observed regurgitation of the bladder contents into the ureters. Lewin observed regurgitation of colored fluids from the bladder to the pelvis of the kidney under the same conditions.

Courtaud and Albarran (7) in 1894 repeated Lewin and Goldschmidt's work but used dogs and found that regurgitation of the bladder contents occurred but differed in their view as to what grade of intravesical pressure was most favorable to regurgitation.

Young (8) in 1898 had six cases of contracted bladders with cystitis which he dilated by hydraulic pressure but observed no evidence of ascending infection.

Sampson (9) in 1903 transplanted the ureter into the unobstructed bladder. Lampblack injected into the bladder never regurgitated into the ureter. Staphylococci injected into the bladder with the lampblack resulted in infection of the kidney in three instances. In 14 dogs however there was no reflux of lampblack. The ureterovesical junction was cut under the same conditions and no reflux of lampblack was observed.

Draper and Braasch (10) in 1913 cut the ureterovesical junction and infected the bladder but no kidney changes were noted.

Kretschmer (11) in 1916 observed in some clinical work in cystography that regurgitation of the bladder contents into the ureter occurred in three normal bladders of ten children examined, one normal adult bladder and three adult pathological bladders with out dilatation of the ureterovesical orifice showed regurgitation of the contents in the ureter under the V ray.

The direct extension of infection from the bladder through the wall of the ureter has been seen in tuberculosis and was shown experimentally by Bauereisen (12) to take place occasionally.

Eisendrath and Shultz (13) also mentioned its occurrence in some of their experimental work although all of these observers believed the infection spread along the lymphatics to invade the kidney.

The lymphatics of the urinary tract have received careful study from a number of competent investigators beginning with Mascagni (14) in 1787 who described a lymphatic connection between the ureter and kidney and glands along the vena cava into which they drained.

Teichman (15) in 1861 and Krause (16) in 1876 described lymphatics in the ureteral mucosa but Sappey (17) working with the ureters of horses in which the structures were gross enough to distinguish more thoroughly the capillaries from the lymphatic vessels could only demonstrate lymphatics in the muscularis of the ureter.

Gerota (18) in 1897 working with his Prussian blue injection material made a careful study of the lymphatics of the bladder and demonstrated well defined lymphatics of

the muscularis which connected with those of the muscularis of the ureter and which drained into the hypogastric glands along the iliac artery. At first he described lymphatics of the mucosa and submucosa but later after further study concluded that these structures were blood capillaries. Gerota also studied the ability of the bladder to absorb colored materials both fluid and solid from the intact mucosa of the bladder but was unable to demonstrate any positive findings.

Kumita (19) in 1897 and Stahr (20) in 1900 demonstrated deep and superficial lymphatics of the kidney parenchyma and lymphatics of the fatty capsule which anastomosed with those of the kidney both of which drained into glands along the vena cava. Lymphatics of the pelvis of the kidney were also demonstrated uniting with those of the ureter and kidney.

Sakata (21) in 1903 made a very careful study of the ureteral lymphatics but was unable to demonstrate lymphatics in the mucosa or submucosa. He demonstrated by Gerota's method anastomosis of the muscularis and periureteral lymphatics with the bladder and kidney and clearly showed the drainage of the lower ureter into the hypogastric glands and the middle and upper ureteral lymphatics to the lumbar glands and that an anastomosis between the two sides could occasionally be injected.

Nothing of consequence was added to this work until Bauereisen in 1910 using fresh ureters of stillborn infants as well as those of the calf and ape demonstrated lymphatics in the submucosa by the use of silver nitrate and by Gerota's method. He also called attention to the anastomosis of the lymphatics between the different coats of the ureter.

Coincident with the demonstration of lymphatics of the submucosa of the ureter and their anastomosis with the lymphatics of the muscularis and periureteral tissues Bauereisen advanced the opinion that in spread of infection from the bladder to the kidney the choice of routes would be by way of the lymphatics of the ureter. By experimental and anatomical study he called attention to the lymphatic infiltrate in the wall of

the ureter without involvement of the mucous membrane in cases of tuberculosis of the bladder stating that in extensive tuberculosis of the bladder the infection is carried first to the lower segment of the ureter and wanders toward the kidney in the periureteral lymphatics

Stewart (22) in 1910 transplanted the ureters into the intestine and observed involvement of the kidney in a suppurative process some instances occurring where pyelonephritis and kidney abscess were present, which he felt could only be accounted for by spread of infection along the ureteral lymphatics

Sugimura (23) in 1911 described round cell infiltration of the ureteral muscularis and submucosa in some cases of acute cystitis occurring in pneumonia tuberculosis and carcinoma of the bladder and stomach. The mucosa of the ureter in these cases was normal in appearance. He believed this microscopic picture was due to the spread of infection from the bladder through the lymphatics. No bacteriology of the blood or genito-urinary tract was mentioned.

Sweet and Stewart (24) in 1914 in a variety of transplantations of the ureters into the intestinal tract and substitution of rubber tubing for a segment of the ureter studied the cases as to the route taken by the ascending infection. They appear convinced from their experimental study that the ascending infection traveled exclusively in the ureteral lymphatics to the kidneys. They evidently concluded because of no mention of bacteriological study of the ureteral and pelvic lumen and of the blood stream that evidence of periureteral and pelvic infiltration is synonymous with infection of the lumen of the urinary tract. That infections by this route may take place is we believe without doubt, but it is equally true that periureteral or pelvic infiltration may be present without infection of the urinary stream and conversely that urinary tract infection may take place through the lumen of the ureter without demonstrable involvement of the lymphatics as our experiments show. Blood infections are not uncommon in ureteral transplantation into

the intestinal tract as Zeit and Peterson have shown but in Case 4 which Sweet and Stewart report in which the unbroken ureters were hung in the lumen of the sigmoid with a resulting periureteral infiltration and pyonephrosis no mention is made of blood culture. It appears that their conclusions are somewhat dogmatic considering the evidence produced.

Eisendrath Kahn and Shultz (25) in 1915 1916 and 1917 injected organisms into unobstructed non traumatized bladders of rabbits and dogs and described a round celled infiltrate of the submucosa of the bladder extending into the ureter where it was present in the submucosa or periureteral lymphatics involving the subpelvic tissue and kidney. They believe that infection from the bladder involves the upper urinary tract by this route. Careful bacteriology and microscopic study were recorded in this work as well as a study of control animals.

Involvement of the upper urinary tract from the bladder by way of the general blood stream has been mentioned by Cabot and Crabtree (26) who obtained positive blood cultures in one third of their cases of colon bacillus pyelitis. Eisendrath and Shultz after injection of bacillus coli into the ununjured unobstructed bladder found the blood sterile at postmortem in a varying number of days after the injection. A thorough bacteriological study of the blood stream however was not attempted.

The literature of infection of the urinary tract from other foci by way of the blood stream or by lymphatic extension from the large intestine has purposely been omitted as it is outside the scope of this paper but from the brief review of the literature concerning ascending infections of the urinary tract it is evident that while unanimous opinion on this subject does not exist the recent work leans strongly to the view of ascent of infection by way of the lymphatics of the ureter.

Considerable of the work loses value because of lack of proper control which is most essential to reasonable deductions. Prior to actual experimental work the bacteriology of the urine of the animals used should be

known and in addition to thorough microscopic examination of the urinary tract at postmortem bacteriology of the blood and urinary tract should be carried out. Personally I believe that where microscopic pictures of tissues influence materially the conclusions drawn from the experimental study the study of control tissue taken from the animal before experimental work should be undertaken when possible as a basis of comparison. For instance in 39 dogs the control ureter removed just prior to establishment of experimental conditions showed no evidence of cellular infiltration in 14 in the submucosa in 10 others and marked round cell infiltration in 5. Only 2 of more than 45 laboratory dogs including the above had organisms in the control bladder urine. The control bladder urine was sterile in the 5 animals showing the marked infiltration in the control ureters. While the microscopic examination of one segment of the ureter does not absolutely indicate the amount of cellular infiltration in the remainder of the urinary tract it is however a valuable index of the deviations from the normal and lessens the tendency to attribute too great pathological importance to clumps of round cells found in the genito urinary tracts of dogs.

SCOPE OF WORK

We have attempted to determine in this experimental work (1) The reaction of the bladder under varying conditions of traumatism and obstruction to the colon bacillus (2) The involvement of the upper urinary tract from these acutely infected bladders (3) The probable routes by which this extension takes place.

Dogs have been used exclusively in this work because they are easily infected by colon bacillus and are the hosts of bacillus coli like organisms. In addition their genito urinary tract grossly and microscopically closely resembles that of the human and much of the study of the lymphatics of the genito urinary tract has been done on dogs. Bacillus coli was chosen as the organism of choice in this work owing to its presence in over 50 per cent of all types of non tuber-

culous urinary infections its rapidity of growth in the urine and ease of cultural recovery. About 2 to 4 cubic centimeters of a thick suspension of colon bacillus washed from twenty four hour agar slant culture were used in each case. These organisms were first obtained from a case of cystitis in a human and then used from one dog to another. As dogs are somewhat liable to infections of various types cultures of the urine before operation were made in all cases and animals having urinary infections were excluded. All of the animals used in this work had a section of the right ureter removed for microscopic study as a control and by ligation of the right ureteral stump conditions were established for the formation of a hydronephrosis on that side. This was done for two reasons namely to control the possibility of infection of the urinary tract by lymphatic extension from the large intestine which Franke (27) has shown is most liable to occur upon the right side and in addition — and of most importance — to have an added control at all times on the possibility of blood stream infection as it is well established by experimental work which we have repeated that organisms in the blood stream are secreted in the urinary tract with almost unfailing exception. We have also repeated this work with acutely developing hydronephroses with positive results. It is assumed then that if the blood cultures made at autopsy in these animals were sterile that an added control would be had where the hydronephrosis was sterile in that temporary blood stream infection could be excluded.

TECHNIQUE OF EXPERIMENTAL WORK

A short description of the operative procedure will suffice for all of the experiments unless exceptions are noted. Sterile technique was employed. Female dogs were used. The abdomen was shaved and iodined and after the skin incision was made sterile laparotomy towel was clipped to the skin. The bladder was delivered the right ureter divided about one inch from the bladder. A piece of the right ureter was removed for microscopic study and the peritoneal stump of the ureter ligated and dropped back. In a series of experiments to be hereafter described a small pipette was introduced through the distal ureteral stump into the bladder and urine was aspirated for culture. Bacillus coli was injected

into the bladder after which the ureter was ligated close to the bladder wall and buried. In another group the distal ureter was ligated at once and a fine record needle was introduced through the fundus of the bladder urine aspirated for culture and bacillus coli suspension injected. In a few dogs before injection of the culture 2 cubic centimeters of turpentine were injected into the bladder and washed out thus increasing the element of trauma to the bladder mucosa. A pursestring suture of fine silk closed the site of puncture. In one series of dogs the bladder was partially obstructed the urethra just distal to the bladder could be reached through the same incision and a silk ligature or piece of fascia was tied around it so as partially but not absolutely to constrict it. The abdominal wall was closed in layers and the abdominal wound covered by an iodoform gauze collodion seal which obtained clean wounds in the majority of cases.

The dogs were killed by ether in periods varying from 1 to 34 days after the operation. A median postmortem incision was made the left ureter was isolated with sterile instruments and a section removed to be ground and cultured. The end of the ureter was then seared and a sterile pipette passed through the proximal end aspirating the contents of the pelvis and ureter on that side. Cultures from the bladder urine right hydronephrosis and blood from the heart were also made under strictly sterile precautions. Sections for microscopic study were then cut from the bladder ureterovesical junction different portions of the right and left ureters the pelvis and cortices of both kidneys. They were immediately placed in Mueller's fluid and then blocked and cut in paraffin where in many instances serial sections were studied.

EXPERIMENTS WITH UNOBSTRUCTED BLADDER

In 7 dogs having unobstructed non traumatized bladders 6 had colon bacilli recovered from the bladder urine at postmortem from 4 to 32 days after the operation and one 34 day dog had sterile urine.

Six of these bladders were negative microscopically both on the serous and cut surfaces with the possible exception of a moderate hyperæmia of the mucosa in 2 dogs. In 1 dog there was a moderate fibrinous exudate over the peritoneal surface of the bladder. Of the normal appearing bladders 3 were microscopically free in all levels of cellular infiltration after 5, 17 and 34 days. In these 3 dogs the right and left ureter right and left pelvis and right and left kidney showed no cellular infiltration of any kind and in 2 of these dogs having bacillus coli in the urine bacillus coli was also grown from the left ureter and pelvis. In these three cases the blood was sterile the right hydronephrosis was sterile and the left ureteral wall stained for microorganisms was negative.

In the 2 dogs with positive cultures in the bladder left ureter and pelvis with absence

of cellular infiltration in any of the tissue, and with sterile blood and right hydronephrosis we believe the infection traveled by way of the ureteral lumen from the bladder (Fig 4).

Three dogs of this same series (the unobstructed bladder experiments) presented gross fibrinous exudate on the peritoneal surface of the bladder in 1 instance and microscopic evidence of it in the others which was probably due to operative trauma plus infection by bacillus coli at the time of its injection into the bladder. In these three dogs the muscularis and submucosa of the bladder were negative. Cultures from the left ureter left pelvis and blood were negative in all 3. The microscopic study of the left ureter in these 3 cases showed periureteral exudate diminishing as the pelvis was approached and the pelvis showed a very few round cells in two instances and was negative in the other. One kidney showed a few round cells but no definite exudate was found in any of the kidneys in these 3 experiments.

On the right side in all 3 cases despite a defect in the ureter a definite periureteral exudate of polymorphonuclear cell type was found reaching to the pelvis where it became most intense in the fat under the pelvis. In one of these the right hydronephrosis had been converted into a pyonephrosis in the 23 days that had elapsed since the beginning of the experiment. The blood was sterile in all instances.

These 3 experiments illustrate the fact that a peritoneal exudate on the bladder extended through the periureteral tissue becoming less on the left side the higher the section was taken or even absent in the pelvis and kidney. In spite of this periureteral infiltration which was of the polymorphonuclear cell type there was no evidence of its extension into the muscularis or submucosa of the ureter or pelvis of the kidney. Cultures from the ureter and pelvis of the kidney were sterile.

On the right side the conditions were very similar except that the infiltrate was most marked in the fat under the pelvis of the kidney. In the 23 day experiment with the pyonephrosis on the right side it is open to question whether a temporary blood stream infection was responsible for the infection of the urine even though the blood at post mortem was sterile. It seems more reasonable from the microscopic evidence in the uninfected cases to assume that direct extension of the subpelvic inflammation through

the pelvic mucosa had infected the urine on that side. The 4 and 6 day dogs with periureteral and subpelvic exudate were sterile though lapse of more time might have caused infection of the right hydronephrosis.

These two cases with the sterile hydronephrosis demonstrated that periureteral and subpelvic polymorphonuclear infiltration is not synonymous with infection of the urinary tract even though 4 and 6 days respectively had passed since the onset of the infection.

The remaining experiment in these unobstructed nontraumatized bladders is of interest.

The dog (experiment 41) was killed after 32 days. The bladder was normal macroscopically though the urine in it contained bacilli coli. The cultures from the left ureter, left pelvis, ground left ureter, right hydronephrosis and bladder were sterile. Microscopically a definite round cell infiltration such as Eisendrath and Shultz described in their work was present in the submucosa of the bladder, left ureter and left pelvis. All other coats were negative (Fig. 2).

This infiltrate does not correspond to any we have found in this series either as to the character of the cells or as to the location of the infiltrate in the submucosa. The control ureter before operation did not present this finding but as all cultures from the urine of the left ureter, left pelvis and from the ground ureter were negative and as the cellular exudate was of the round cell type with some plasma cells in it we cannot regard it as evidence of spread of a bacterial infection which was then present in the bladder.

In 3 experiments the bladder was traumatized by needling for aspiration of the urine and in 2 of these turpentine was injected and washed out before injection of the colon bacilli. Bladder cultures after four to six days were positive in all. Grossly and microscopically the turpentine bladders showed a marked edema (and hyperemia) of the mucosa. In addition microscopically the submucosa contained isolated polymorphonuclear leucocytes but no dense infiltration. The muscularis and serosa were negative except at the needled areas where a moderate reaction occurred. In the dog having turpentine bladders the left ureter and pelvis were sterile and microscopically showed no infiltrate of any coat. In 1 of these dogs the divided right ureter was in contact with the bladder and in this instance some polymorphonuclear leucocytes were

found beneath the pelvis of the right kidney. The second dog showed no infiltration on the right side and the right kidney urine as well as the blood cultures in both dogs were sterile.

In these two experiments the reaction of the submucosa to the irritating element is seen but no evidence of an ascending infection either by culture or by microscopic study was present on the left side.

In the third dog of this series (experiment 27) a hose bladder was needed but in which no turpentine was used. The autopsy on the fourth day showed the bladder covered with omentum and the right divided ureter adherent to it. The mucosa of the bladder was slightly hyperemic. The right kidney urine and blood were sterile but bladder urine, the left kidney pelvis and left ureter contained bacilli coli. Microscopically there was a marked polymorphonuclear exudate on the peritoneal surface of the bladder and to a lesser degree in the submucosa. The muscularis was negative. The left ureter at the vesical junction had a marked periureteral exudate which invaded the muscularis and submucosa to a less degree. Higher in the ureter the exudate was limited to the polymorphonuclear type and this was present in the pelvis of the kidney and in the kidney substance between the collecting urinary tubules just peripheral to the calices. On the right side there was a moderate polymorphonuclear infiltrate in the perireteral tissue becoming less as the ascent of the ureter was made and the right kidney showed no infiltrate and the right hydronephrosis was sterile (Fig. 3).

This is an instance where the microscopic evidence would justify the belief that the periureteral exudate spread by contiguity to invade the muscularis and submucosa of the ureter to a point where infection of the lumen of the ureter might occur. In this case however it is also logical to believe that the infection in the periureteral lymphatics involved by the way of the pelvis the kidney itself in an acute process.

This opportunity should be taken to emphasize the importance of the microscopic character of the exudate when it is used as an index of active infection due to the colon bacillus. In experiment 27 just discussed a polymorphonuclear periureteral infiltrate was present. Ground cultures of the ureter gave a pure culture of bacillus coli. In this dog colon bacilli were also present in the bladder urine. In experiment 41 with bacillus coli in the bladder urine and with marked



Fig. Variation in control ureter. Both dogs had sterile urine at time tissue was removed. L (at left) Lumen of control ureter shown no cellular infiltration. R (at right) Lumen of control ureter showing marked round cell infiltration of submucosa.

round cell infiltrate in the submucosa of the ureter such as described by Eisendrath and Shultz and said by them to be evidence of organisms of low virulency the ground cultures of the ureter were sterile (Fig. 3).

Summarizing these experiments in the unobstructed bladders into which bacillus coli had been injected it was found that the bladder urine contained bacillus coli in 9 experiments over a period of from 5 to 34 days and was sterile in 134 day experiment.

The left ureter and pelvis contained bacillus coli only 3 times.

The right hydronephrosis was sterile in all but 1 experiment.

The untraumatized bladders showed no evidence of involvement of the muscularis or submucosa of the bladder by acute inflammatory exudate.

In the turpentine bladders there was oedema and moderate polymorphonuclear infiltration of the submucosa of the bladder. Four bladders showed polymorphonuclear peritoneal exudate but no acute exudate in any other coat of the bladder and in one instance the periureteral lymphatics contained decided evidence of polymorphonuclear infiltration which decreased in amount as the ureter was ascended and which in one instance involved the entire coats of the ureter and pelvis and caused a similar exudate in the kidney. Bacillus coli was isolated from the pelvic urine on that side.

Most important however by the pre-

ponderance of its occurrence is the absence of infection in the urine and on the epithelial surface of the left ureter and kidney pelvis in the other 4 experiments where periureteral exudate was present. It should be emphasized that periureteral infiltration is not synonymous with infection of the urinary stream. On the other hand infection of the ureter and pelvis of the kidney may occur where bacillus coli is present in the unobstructed non-traumatized bladder without any microscopic evidence of involvement of the wall of the bladder ureter pelvis or kidney and with sterile blood and right hydronephrosis. This is instanced in a 5 and 17 day dog experiment and is experimentally proof controlled by bacteriological and histological study that infection may extend through the lumen of the ureter to involve the upper urinary tract (Fig. 4).

Experiment 34 November 1 1916 Female dog. Right ureter divided 2 inches from bladder and ligated. Bacillus coli injected into bladder through stump of right ureter. Right ureteral stump ligated near the bladder. Bladder urine taken at operation sterile. *Postmortem December 8 1916* No infection of peritoneum left ureter and pelvis normal in appearance right ureter not in contact with bladder the size of a lead pencil the right pelvis dilated four times the size of the left contained ounces of clear urine under pressure. The bladder was normal in size the peritoneum smooth. The cut surface was negative except for slight hyperemia.

Bacteriology Blood culture sterile right kidney urine sterile bladder contains colon bacillus left ureter contained colon bacilli.



Fig 4 A

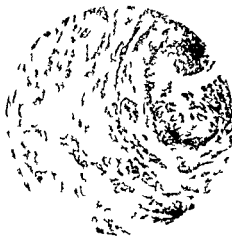


Fig 4 B

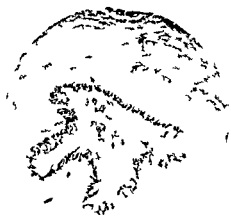


Fig 4 C



Fig 4 D



Fig 4 E

Fig 4 E. In 4 dogs, 1 animal had a polymorphous infiltrate at the left ureterovesical junction most intense peripherally but reaching through the muscularis to the submucosa. In one of these dogs this infiltrate was in the periureteral tissue for a short distance up the ureter and was absent in the pelvis of the kidney and kidney. Colon bacilli were isolated from the ureter and pelvis of the kidney. In the other dog periureteral pelvic and kidney infiltration were absent in the left pelvis and ureter were sterile though the infiltration at the left ureterovesical junction was marked.

Fig 4 D. In 4 dogs, 1 animal had a polymorphous infiltrate at the left ureterovesical junction most intense peripherally but reaching through the muscularis to the submucosa. In one of these dogs this infiltrate was in the periureteral tissue for a short distance up the ureter and was absent in the pelvis of the kidney and kidney. Colon bacilli were isolated from the ureter and pelvis of the kidney. In the other dog periureteral pelvic and kidney infiltration were absent in the left pelvis and ureter were sterile though the infiltration at the left ureterovesical junction was marked.

Here again we have the possibility of infection of the upper urinary tract by direct extension of infection from the bladder wall through the wall of the ureter but actual infection was present in only one of the two examples. It is noteworthy that in the presence of this marked inflammatory reaction at

the ureterovesical junction that only a moderate degree of ureteral infiltration was found in the lower ureter in one animal and in the other not at all and higher no infiltration of the pelvis of the kidney or kidney was present in either case. The ground ureter showing no infiltration was sterile.

In 5 dogs killed on the second to the fourth day there was an infiltration of all coats of the bladder wall but the left ureterovesical junction showed no microscopic evidence of invasion of the wall of the ureter as it entered the bladder and sections of the left ureter pelvis and kidney showed no infiltration in any part. From the left ureter and pelvis of the kidney of the 5 dogs colon bacilli were isolated in pure culture. Blood culture were sterile. It may be stated that in those instances where the right divided ureter was in contact with the bladder or the fibrinous exu-



Fig 5 A



Fig 5 B



Fig 5 C



Fig 5 D



Fig 5 E

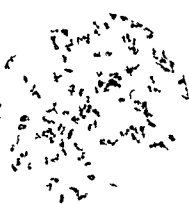


Fig 5 F

Fig 5 A E m t a t d t t m t m l t l l y
b t t d b l d d t h l r t t f t l m u d
m i c f l t a t f l l t f t h l l d d l
T l g h t d l d t d h t t t l b l d d
B l l s o l t a l l t u f m t l b l d
l k f t t d l t k d y p e l l c t h s l t
l y d p h i n d b l o o d t l Th

m s t l f f t l t t t t h l t t t
p e l k d v l l t l s l t f h d p a f l f t
d u p l p o l y m p h i a f l t t f l f t
t l j t B l f t t l m f t h t
C l f t p e l D l f t k d v l h t t t h f
t f m f t t f h t b p l f l t t

date around the right distal stump of the ureter a periureteral polymorphous exudate reaching to the fat beneath the pelvis of the right kidney a present though the hydrocephalus. These conditions are presented here to establish the fact that sufficient time had elapsed for spread of infection through the lymphatics (Fig 5).

These five experiments exclude all other channels for infection of the left urinary tract except ascent of the infection through the lumen of the ureter.

In one dog killed on day after the permanent constriction of the ureter a found to be negligible red the bladder as not distended and showed no evidence of infection. Microscopically the bladder left ureterocal junctum ureter pelvis and kidney were negative for infiltration as

was the right side. All cultures except from the bladder were sterile. The experiment corroborates the findings of true infection through the ureter.

In the remaining four dogs killed at the first five days after the permanent obstruction of the bladder highly polymorphous exudate all have periureteral exudate a fluid hanging into the muscular and highly inflammatory nature of the exudate but remaining peritonsillar the infection. The left kidney in the four dogs each showed no evidence of infection in the subcapsular in one permanent raised cellular red polymorphous exudate leukocytes in the interstitium and glomeruli the remaining one. The left kidney showed no filtration in any case. In these four dogs the left residual bladder left ureter left pelvis of the kidney contained colon bacilli. The use of that the infection of the left may have been by the lumen of the ureter or by direct contact through

the ureter into the lumen of the ureter from periureteral infiltration or remotely possible by involvement of the pelvic mucosa by spread of inflammation by contiguity from the exudate deeper in the pelvic fat.

In 11 dogs with partially obstructed bladder showing involvement of all coats by polymorphonuclear infiltration the involvement of the right divided ureter and right hydronephrosis will be summarized. In 3 dogs the proximal stump of the right ureter was adherent to the bladder or was in free exudate and in all instances periureteral and subpelvic infiltration of polymorphonuclear cells was present. As a rule the infiltration in the subpelvic fat was the most pronounced. The muscularis and submucosa in all instances was negative as was the pelvis and kidney except in 1 dog where there was an invasion of the submucosa of the pelvis of the kidney and in this experiment bacillus coli were grown in the urine from the right kidney. In the other dogs the urine from the right hydronephrosis was sterile. In 3 dogs where the proximal stump of the right ureter was not adherent to the bladder or in exudate there was no infiltration of the ureter pelvis or kidney except in one experiment where there was some periureteral and subpelvic infiltration. In all of these cases the right kidney urine was sterile.

These findings demonstrate that the divided, ligated ureter in contact with infectious material is subject to spread of this infection along the periureteral lymphatics into the subpelvic fat which is the seat of the greatest reaction. The urinary stream may be involved by direct extension through the submucosa of the pelvis which occurred in 1 case. In the other 10 experiments the urine of the right hydronephrosis was sterile and the kidney showed no evidence of infiltration in any case. These results are in decided contrast to the urinary tract on the left side in which in these same dogs the ureter was undivided and showed periureteral and subpelvic exudate in only four instances but had positive cultures of bacillus coli grown from the left ureter or left pelvis of the kidney in 10 out of 11 of the experiments.

It is noteworthy that periureteral and subpelvic lymphatic infiltration was present without infection of the urinary stream in 10 of 11 experiments on the side of the right divided ureter while infection on the side of the left undivided ureter in the same dogs was present in 10 of 11 cases. We believe this was unmistakably due to involve-

ment of the left side by way of ascent of infection from the bladder through the lumen of the ureter since the blood was sterile in all cases and the right hydronephrosis was sterile in all but one.

CONCLUSIONS

1 Injection of bacillus coli into unobstructed non traumatized bladders is not followed by cellular exudate in the submucosa or muscularis in most instances.

Bacillus coli may be isolated from the urine of the unobstructed non traumatized bladder showing no evidence of microscopic infection as late as a month after its injection into the bladder.

2 Acute high grade cystitis in obstructed and unobstructed bladders is not accompanied by blood stream infection.

3 Cystitis in unobstructed bladders is not commonly accompanied by extension of the infection to the upper urinary tract.

4 It is possible in an unobstructed bladder to infect the upper urinary tract by direct extension of the infection from the bladder through the lumen of the ureter.

5 Cystitis in partially obstructed bladders is very frequently accompanied by the presence of the infecting organism in the ureter and pelvis of the kidney and this extension may take place by the lumen of the ureter or by direct involvement of the ureter by inflammation by contiguity or possibly by way of the periureteral lymphatics and infection of the subpelvic tissue.

6 Evidence is presented to show that ascending bacillus coli infection of the upper urinary tract from the bladder travels most frequently by the lumen of the ureter.

7 Periureteral infiltration is present only when peritoneal exudate of the bladder or pelvic peritoneal exudate is also present.

8 Periureteral or subpelvic exudate is not synonymous with infection of the urinary stream.

9 In the presence of periureteral or subpelvic infiltration the kidney parenchyma is negative in most instances.

10 The infection of a hydronephrosis where the ureter is ligated and divided and comes in contact with infectious material may take

place by spread through perireteral lymphatics to the subpelvic fat and by contiguity involve the pelvis of the kidney. In these experiments this process did not progress rapidly in point of time.

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AN EXPERIMENTAL AND CLINICAL STUDY OF CHLOROFORM ETHER AND NITROUS OXIDE-OXYGEN IN PREGNANCY AND LABOR¹

By C HENRY DAVIS M.D. C. C.

ALTHOUGH many valuable studies have been made of chloroform ether and nitrous oxide-oxygen several papers published during the past year show that clinicians are not agreed in the use of these anesthetics. The present report is offered not in the belief that it is conclusive but with the hope that it will stimulate further and more careful research both clinical and experimental.

That the value of an experiment depends upon the number and range of controls is

axiomatic. In this study age pre-existing disease stage of pregnancy number of embryos diet manner of handling temperature etc. must all be considered in the correlation of results. Macroscopic and microscopic evidence of tissue change may be observed yet without the combined efforts of the pathologist cytologist and physiological chemist it is impossible to determine the exact nature of the changes. An effort has been made to control each experiment but as will be seen later pre-existing diseases made

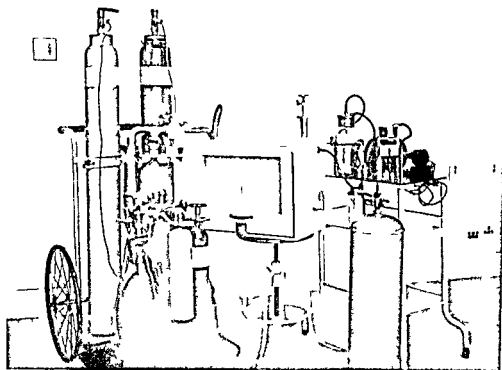


Fig. 1. Nitrous oxide machine with automatic regulators and nitrous oxide chamber, oxygen tank and pump used in experiments.

this very difficult. The tissue changes noted are explained in the light of published observations rather than of personal investigations in cytology.

While surgeons and anesthetists are agreed that chloroform as generally administered is by far the most dangerous anesthetic they differ regarding the relative safety of and indications for nitrous oxide oxygen and ether. Because of experimental work chiefly on non pregnant animals it has been considered by many of us that nitrous oxide oxygen is the most desirable anesthetic in pregnancy and labor. But a smaller number of clinicians hold a different opinion one going to the extreme of declaring nitrous oxide oxygen the most dangerous anesthetic.

In the present investigation objections to many of the former experiments were removed by using an anesthetic chamber (Fig. 1) in which groups of animals could be anesthetized under identical conditions. The concentration of CO_2 was limited by having a false floor three inches from the bottom of the box under which was placed a solution of lime water or sodium hydrate and having a ventilating valve near the bottom as well as in the top. The chloroform and ether were

dropped on a sponge suspended near the top and vaporized by the current of air or the oxygen which passed through the sponge. The nitrous oxide oxygen mixture was passed into the chamber under constant low pressure and in suitable proportions for analgesia or anesthesia. The condition of the animals could be noted at all times through the glass door. Controls were made to lessen the possibility of unwarranted conclusions. The animals were examined as soon as possible after death the tissue hardened in Zenker's fluid and the sections stained with hæmatoxylin and eosin. No special stains were made except Sudan III of frozen sections to demonstrate the presence of fat in the liver.

GENERAL DESCRIPTION OF GROUP EXPERIMENTS

Chloroform Chloroform air. Three pregnant and one non pregnant guinea pigs were lightly anesthetized two hours daily until they had a total of six hours and fifteen minutes anesthesia. The temperature in the box was never lower than room temperature. A constant current of air insured an abundance of oxygen. From five to even minutes was needed to anesthetize the

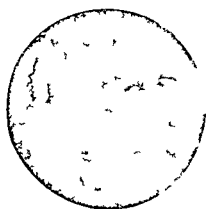


Fig 1



Fig 3



Fig 4



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Fig 6



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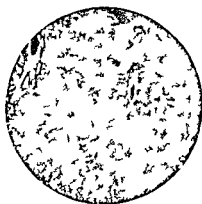


Fig 8



Fig 9

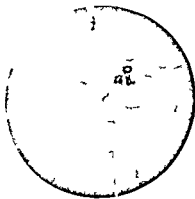


Fig 10

(Fig 10 d p p t p g)

animals There was very little struggling or other evidence of excitement They were always able to move about the cage within a few minutes after being removed from the box Their respirations were always under sixty per minute One animal stopped breathing shortly after the second anæsthetic was started and had to be resuscitated

Clinical results One pig aborted during the night following the first anæsthetic The non pregnant pig that stopped breathing at the start of the second period died in convulsions twenty one hours after the last anæsthesia A second animal aborted during the night following the third anæsthesia and died in convulsions twenty two hours after its completion The remaining pregnant pig delivered a single live young one three weeks after the completion of the experiment The pig which aborted after the first period survived until killed five weeks after the anæsthetic

Chloroform oxygen Two pregnant and one non pregnant guinea pigs were placed in the box and lightly anæsthetized with chloroform oxygen being supplied instead of air Forty gallons of oxygen were passed into the box during the anæsthesia which lasted one hour The pigs recovered within a few minutes and the following morning seemed perfectly normal in every respect The non pregnant pig was killed forty eight hours after the completion of the anæsthetic The pregnant pig delivered one and two live young respectively sixteen days later They were killed with their mothers forty eight hours after birth The two smaller pigs were in a bad physical condition and undoubtedly would have died within a few hours The condition of the larger one seemed fairly normal

Ether and air Three pregnant and one non pregnant guinea pigs were placed in the box and anæsthetized two hours daily for two days three hours and fifteen minutes the third day After the first anæsthetic one gave birth to two normal young and these were anæsthetized with their mother during the remaining five hours and fifteen minutes

To my surprise the young seemed to stand the ether mixture quite as well as did the adult pigs and recovered as quickly following the anæsthetic The respirations of the animals varied from 60 to 100 per minute They were usually found to be eating within twenty or thirty minutes after the completion of the anæsthetic The non pregnant and one of the young pigs were placed in the box with a normal control pig forty eight hours after the completion of the anæsthesia anæsthetized and killed by cutting their throats The remaining pregnant pig delivered two live young nineteen days after the completion of the anæsthesia One of these died within forty eight hours and the other within seventy two hours after birth The two adult and one young that survived the anæsthesia were killed twenty two days after the completion of the anæsthesia

Nitrous oxide oxygen anæsthesia Three pregnant and two non pregnant guinea pigs were placed in the box and anæsthetized on four successive days until they had a total of seven hours forty five minutes nitrous oxide oxygen anæsthesia At the end of this period one of the pigs died under very deep anæsthesia from which the others recovered within two minutes after being removed from the box

It was rather hard to maintain a perfectly even anæsthesia as they seemed very sus-

Fig. 2 Extensive necrosis of liver following six hours of light chloroform anæsthesia

Fig. 3 Round cell infiltration of liver of adult pig dying under deep nitrous oxide anæsthesia

Fig. 4 Passive congestion of loss of stain power in liver of guinea pig killed by nitrous oxide asphyxia

Fig. 5 Fatty change on section loss of stain power and infiltration of cholesteryl crystals in liver of guinea pig killed by slow asphyxia in a bell jar

Fig. 6 Marked passive congestion cell destruction and fatty changes in liver of stillborn pig mother given six hours of chloroform anæsthesia

Fig. 7 Fatty change in liver of a young pig born 19 days after the mother had three repeated anæsthesias with ether

Fig. 8 Round cell infiltration which was observed in the livers of young stillborn after nitrous oxide-oxygen anæsthesia

Fig. 9 Sudan III stain of frozen section of the liver of a young pig born alive after mother had one hour of chloroform oxygen anæsthesia showing extensive fatty changes

Fig. 10 Same liver as in Fig. 9 the aculeoles being evidence of the extensive fatty changes

ceptible to slight change in the percentage of the oxygen added to the mixture. There seemed to be considerable difference in the susceptibility of the different pigs. The pregnant pigs were more susceptible to the mixture than the non pregnant. The long haired pigs in the group had to be removed from the box the first period and resuscitated. The respirations ranged from 60 to 100. Three or four minute was required to anesthetize them. They were usually a little restless as they began to lose control of their bodies and to topple over on the floor. They usually went to eating within two or three minute after removal from the box.

Mortality. One pregnant pig died near the end of the anæsthesia. A second pregnant pig died twenty two days later of tuberculosis and general peritonitis macerated young being found *in utero*. The third pregnant pig which aborted died of right lobar pneumonia thirty two days after anæsthesia. All the young were killed *in utero*. The two non pregnant pigs were killed by general pharynx two month after their anæsthesia. This was an error as it prevented the finding of any microscopic evidence of pathology which may have remained from repeated anæsthesia. But the occurrence of marked hemorrhage from the capsule of the liver which was not seen to any extent in other pigs, a pharynxed by nitrous oxide or simple lack of oxygen suggest strongly that the liver of the pig had been injured to such an extent that complete restoration had been impossible in a period of two month. (The anæsthetics were given in February and the animal room was often very cold at night.)

2. **Nitrous oxide oxygen analgesia.** Three pregnant and one non pregnant guinea pigs were given nitrous oxide containing from 0 to 30 per cent oxygen two hours daily until they had a total of six hours general analgesia. One of the mother went into labor just before the beginning of the second period and the second of her young was delivered in the box and lived its first half hour in a gas oxygen atmosphere. A second mother delivered three young after the second analgesia. The five young were placed in the box with the adults during the third period.

It was found that the young pigs were more susceptible to this mixture than were the mothers and they would be lightly anesthetized in a mixture containing over 50 per cent of oxygen while the mothers were able to move about the box with a slightly unsteady gait. The pregnant pigs seemed to be more susceptible to the mixture than were the non pregnant and delivered pigs. The respirations were over 60 per minute but not as rapid as observed during anæsthesia with nitrous oxide oxygen.

The pig carrying its young throughout the analgesia aborted the night following the third period having a litter of three (sections show pathology not caused by gas). The pig born in the box was found dead the morning following the last analgesia. The second morning two more of the young were found dead. On the fourth morning one of the mothers died of general peritonitis a diphtheroid organism being found in the smears of the peritoneal fluid. Two days later the young of this mother were found dead.

One hour nitrous oxide oxygen analgesia. Two pregnant and one non pregnant guinea pigs were given one hour of nitrous oxide oxygen analgesia using another manual fixture product. The non pregnant pig was killed by cutting its throat fifteen minutes after the completion of the analgesia. Seven days after the analgesia one of the pigs delivered four tillborn young. Thirteen days after the analgesia the other delivered three live and two tillborn young. The three died in the incubator a few hours later. The mother was killed by cutting her throats. In connection with these deaths it must be remembered that with guinea pigs the larger the litter the smaller the young and the greater the mortality following birth.

TOXICITY AS SHOWN IN TISSUES

The tissue changes observed after the long continued administration of the anæsthetic studied are for the most part identical with those reported by Graham and the others who have made similar investigation. The most constant and ever change were found in the liver. The animal dying from chloroform poisoning showed a marked œdema of

the kidney epithelium with a closure of the tubules and a marked congestion of the adrenals with a tendency to hemorrhage into the medulla. Sections of the lungs revealed the presence of tuberculosis in most of the animals used in the experiments. This complication undoubtedly lowered the resistance of the guinea pigs.

Livers of adult guinea pigs. 1. The livers of the two guinea pigs dying less than twenty-four hours after the third anesthesia with chloroform showed the typical central necrosis (Fig. 2). The pigs which lived until killed showed that there was a gradual repair of the injury and their livers approached the normal.

2. The livers of the guinea pig killed at various periods after the long anesthesia with ether showed a loss in staining power presenting a picture similar to that seen after ordinary asphyxiation. This loss in staining power is said to be due to some degree of parenchymatous degeneration and tissue swelling. These changes are of a different type and much less severe than those found in cases of chloroform poisoning.

3. The guinea pig which died during the nitrous oxide oxygen anesthesia showed a marked round cell infiltration of the liver (Fig. 3) which could not have resulted from nitrous oxide. It seems probable that this primary pathological condition was at least partially responsible for the death. The pig killed by nitrous oxide asphyxiation (Fig. 4) showed a loss of staining power and a passive congestion similar to that seen after ordinary asphyxiation (Fig. 5). The maternal change following nitrous oxide oxygen anesthesia while of the same type are undoubtedly less severe than those following ether since the tissue findings more quickly return to the normal.

Changes observed in livers of young. 1. *Chloroform.* The stillborn young of mothers subjected to repeated chloroform anesthesia showed a marked passive congestion (Fig. 6), cell destruction and fatty changes. The animals also showed congestion of the adrenals and edema of the kidney epithelium. The liver of the single young born alive twenty-two days after the anesthesia had a normal liver. It was killed when two weeks old.

Ether. The young pig born during the ether experiment and killed forty-eight hours after its completion showed fatty changes in the liver and some loss in staining power of the cells. Its mate killed twenty days later had a normal liver.

The young pigs born eighteen days after the completion of the anesthesia and dying within forty-eight and seventy-two hours after birth showed loss in staining power and some fatty changes, the destruction being greatest in the one dying first (Fig. 7).

3. *Nitrous oxide oxygen.* No pig was born alive after the long nitrous oxide oxygen anesthesia. The liver of an embryo in the pig dying at the end of this anesthetic showed in almost normal appearance of the liver.

The livers of the three pigs stillborn after six hours of nitrous oxide oxygen analgesia showed a passive congestion, loss of staining power of the cells, and a round cell infiltration (Fig. 8) similar though less marked than seen in the adult dying under nitrous oxide. One of these pigs had a blood clot the size of a hazelnut under the liver. The pigs dying within forty-eight hours after the completion of the analgesia had some passive congestion of the liver and moderate fatty changes. Those living six days had normal livers but died of pneumonia following the death of their mother.

One hour anesthesia. 1. The liver of the control pig killed forty-eight hours after one hour of chloroform oxygen anesthesia appeared normal. One of the two mothers killed fourteen days later had numerous yellowish areas over the surface of the liver which are shown by Sudan III to be fatty. The liver of the other pig was normal.

The livers of all three pigs born alive after the chloroform and oxygen were shown by Sudan III (Fig. 9) to contain a large amount of fat. These changes were also shown to be marked from the number of vacuoles in the regular section (Fig. 10).

The adults killed after one hour of nitrous oxide oxygen anesthesia had normal liver.

The liver of the four stillborn one week after anesthesia showed a marked passive congestion and a loss in staining power such

as has been noted after asphyxia. The livers in the second group of five three of which lived a few hours showed the marked round cell infiltration (Fig 8) in addition to some loss in staining power of the cells.

DISCUSSION

In the present paper no attempt will be made to review the literature which is extensive reference being made to only a few of the more recent articles which bear directly on the present study. The results described are in accord with those who find that chloroform is the most dangerous anæsthetic. They offer additional evidence that chloroform has a destructive action apart from interfering with oxidation in that it causes an actual necrosis of liver cells. They indicate that with each of the anæsthetics there is more danger to the foetus *in utero* than to the mother. And since the young born to mothers which had only one hour of light anæsthesia with chloroform and pure oxygen in excess show markedly fatty livers it is evident that the use of oxygen cannot remove the dangers of chloroform.

These experiments confirm the statements of Graham Sansum and Woodyatt. Chloroform is prone to cause swelling of the cells with fat infiltration, necrosis, a hæmorrhagic tendency, etc. Ether has not been observed to cause necrosis but it may produce milder forms of parenchymatous degeneration and tissue swelling. Nitrous oxide has little tendency to produce any visible tissue changes. This study suggests that nitrous oxide produces cell changes only by interfering with cell metabolism. The changes observed after both ether and nitrous oxide have all been of the type found after a phyxiation yet the fact that a slower recovery is made after ether indicates that it causes a more severe injury than nitrous oxide. This however is more natural since ether enters into a close combination with the lipoids of the body and a considerable period is required for its elimination. Nitrous oxide has the power of quickly displacing oxygen but it is eliminated with equal rapidity and therefore can interfere very little with cell metabolism beyond the period of anæsthesia.

It is the opinion of most laboratory investigators that any narcotic drug given in a sufficiently large dose will interfere with cell metabolism and cause some degree of cell aphyxia with whatever degree of acid increase this implies. The livers of the pigs dying from chloroform poisoning, nitrous oxide asphyxia and ordinary asphyxiation were all acid to dimethylamidoazobenzol. No reaction was obtained from short anæsthesias. It has long been known that glycosuria may occur after a long anæsthesia with some degree of asphyxiation. Laboratory workers have now demonstrated that hyperglycæmia is fairly common. Bradner and Reimann found acetoneuria in 61.7 per cent of Deaver's post-operative cases.

The experimental work reported in the past led the writer and most others to believe that when nitrous oxide was not given to the point of cyanosis it carried no danger to mother or foetus. The present study however shows conclusively that it is possible to kill the foetus *in utero* by the long continued administration of nitrous oxide oxygen even when no macroscopic evidences of asphyxia are observed. Furthermore it is apparent that this danger is not entirely eliminated by supplying oxygen in the percentage found in air.

Several factors probably work together in causing the asphyxiation of the foetus *in utero*. It was demonstrated by Sir Humphrey Davy that nitrous oxide will displace air and oxygen from water. Buxton found that nitrous oxide can actually oust oxygen from its absorption and with great rapidity become associated with some of the blood constituents. And more recently it has been demonstrated that any narcotic interferes with normal cell metabolism. Hence it is apparent that when nitrous oxide oxygen is administered the blood not only contains less than the normal amount of oxygen but the body cells are less able to utilize the oxygen present. Considering with these facts the more or less complicated method of supplying oxygen to the foetus *in utero* it is perfectly logical to assume that the foetus will show greater evidence of asphyxia than the mother.

All experimental work indicates that the dangers from nitrous oxide oxygen without

evident cyanosis results from the long continued interference with cell metabolism. Therefore it is fair to assume that with our very limited intermittent use of nitrous oxide oxygen during the painful stage of labor there is practically no danger. The nitrous oxide is inhaled only during the first four or six inhalations after the beginning of the contraction and is largely eliminated by the time the uterus relaxes to the point that any appreciable amount could be absorbed into the foetal circulation. Normal metabolism is always possible during the interval between contractions.

CHOICE OF ANÆSTHETIC DURING PREGNANCY

The long continued administration of any anæsthetic is a source of danger to the foetus. Chloroform because of its greater toxicity, and nitrous oxide because of its mechanically interfering with the oxygen supply, are apparently more dangerous to the foetus when continuously administered than ether. Ether is better borne by the very young than chloroform or nitrous oxide. Surgical operations should be avoided during pregnancy but when necessary the writer believes that ether is the inhalation anæsthetic of choice.

CHOICE OF ANÆSTHETIC IN LABOR

The danger of each anæsthetic is materially lessened by the intermittent administration in labor and the small amounts employed. The value of an anæsthetic at this time varies in proportion to the degree of analgesia which may be secured during the first few inhalations after the beginning of a contraction. Chloroform and nitrous oxide properly administered afford about equal relief. But chloroform is more toxic, less pleasant and interferes to a greater degree with the progress of labor. The administration of chloroform with pure oxygen is very expensive and probably does not increase its safety. For the patients who cannot afford nitrous oxide oxygen the writer uses etherized air self administered in the way the nitrous oxide is given. This has many advantages over the old method of using the cone and it is very inexpensive. It must be remembered that babies born after the mothers have had chloroform or ether

require many hours to completely eliminate the anæsthetic and therefore the writer believes the intermittent use of nitrous oxide oxygen the safest and most desirable analgesic in labor.

GENERAL CONCLUSIONS

1 The administration of chloroform ether, or nitrous oxide oxygen to pregnant or non-pregnant animals if given over a long period of time and repeated on successive days causes degenerative changes in the tissues. The changes found in the liver are the most constant. Those following the use of chloroform are the most severe.

2 If the degeneration is not sufficiently great to cause death the animal gradually recovers from the effect of the anæsthetic but it seems probable that results of the injury may persist for a considerable time.

3 With ether and nitrous oxide oxygen the changes are chiefly those of cell asphyxiation yet it is evident that the cells recover more slowly following ether than they do after nitrous oxide. The central necrosis following chloroform is very different from that seen in asphyxiation and more permanent.

4 The long continued use of these anæsthetics must be considered dangerous to the foetus *in utero*. Chloroform and nitrous oxide anæsthesia seems more dangerous to the foetus than ether. The continuous nitrous oxide oxygen analgesia while less dangerous than the anæsthesia should not be administered over long periods.

5 The marked fatty degeneration of the livers in all three of the young born after their mothers had only one hour of chloroform oxygen anæsthesia shows that pure oxygen does not remove the danger of chloroform.

6 The changes following the use of nitrous oxide being identical with those seen after ordinary asphyxiation it seems fair to believe them due to long continued interference with cell oxidation.

7 There is no reason for believing that the intermittent use of four or six inhalations of nitrous oxide oxygen at the beginning of the uterine contractions can be of any maternal danger to the foetus. The nitrous oxide

absorbed has been largely eliminated by the end of the contraction and normal metabolism is not disturbed during the interval

8 Since it is evident that anaesthesia during pregnancy may be a source of considerable danger to the foetus it is believed that operation should be avoided if possible during this period. The foetus *in utero* and the newborn would appear to stand either anaesthesia better than chloroform or nitrous oxide oxygen.

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A COMBINED BACTERIOLOGICAL AND HISTOLOGICAL STUDY OF THE ENDOMETRIUM IN HEALTH AND IN DISEASE¹

B ARTHUR H CURTIS MD I ACS C
I h t h l i f f o l log l i l k H i

THE uterus has long been considered a favorite place for localization of chronic infection and countless women have been craped with a curette for relief from endometritis. Many gynecologists have thought that curettage would also result in the disappearance of innumerable other ailments often totally unrelated and centered in tissues far remote.

These views are being slowly discarded but our knowledge of infections of the uterus has not undergone a development corresponding with the improvement in our surgical judgment. That part of the field concerned with infections of pregnant women has been subjected to extensive investigation otherwise the bacteriology of the endometrium is not well known.

The part played by focal infections of the pelvic organ in the causation of chronic systemic diseases remains essentially problematical.

Not only systemic lesions of an anatomic nature but also functional disorders result from infections of the female genitalia. No one can question that serious functional disturbances are often directly traceable to altered internal secretion produced by in-

flammatory pelvic disease. The neurogynecological group of affections promises to offer new problems of interest.

Most of the limited number of studies concerned with the bacteriology of the uterus of the non-pregnant were reported in the early literature. Present-day methods of making cultures such as grinding of the tissues in search for buried foci of infection have not been employed.

It has been my endeavor to search the literature exhaustively for all that it yields pertaining to chronic endometritis including physiological pathological and bacteriological studies. By way of introduction it would seem desirable to summarize such of these papers as appear to have contributed to our knowledge of the subject.

LITERATURE

Histology. In comparatively recent studies Hirschmann and Adler brought forth evidence that most cases classified as endometritis are devoid of histological signs of infection. The varied appearance of the endometrium is ascribed chiefly to changes

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characteristic of different phases of the menstrual cycle. While they admit the occurrence of glandular hypertrophy of the endometrium from other than physiological causes such as fibroids and passive congestion it is emphatically denied that hypertrophic endometrium may result from inflammation.

Hitschmann and Adler likewise insist that inflammation of the uterus never causes hemorrhage. They assert that idiopathic bleeding from the uterus not ascribable to systemic causes is always produced by deranged function of the ovaries.

These authors accept but one form of endometritis, the interstitial. This they believe is similar to inflammation in other parts of the body, but because it is difficult to recognize cellular changes due to almost constant physiological alterations in the endometrium plasma cells are relied upon for diagnosis. They have implicit faith that plasma cells (Fig. 1) are always present and are pathognomonic in chronic endometritis. Buettner¹ takes exception to this. He finds plasma cells present in small numbers without inflammation and he further notes that many have remarked the absence of plasma cells when the process was acute. Henkel, with polychrome stain could not find distinct plasma cell increase even in cases with definite chronic interstitial changes.

In a study of the etiology of uterine hemorrhage Schuckele and Keller² find no relationship between hypertrophy of the endometrium and hemorrhage. Neither do they believe that change in the uterine musculature or connective tissue are responsible for the bleeding.

If we direct our thoughts to the frequency of endometritis, the almost forgotten advice of Emmet is expressed in his text deserves consideration. Emmet warned against the diagnosis of chronic endometritis, he maintained that infection when present is chiefly secondary to lesions of other pelvic organs. This view finds support in a histological study of endometria from 800

pathological cases in Kelly's³ clinic in which Cullen was able to find evidence of non-tuberculous endometritis in only 49. Charles Norris⁴ made histological examination of 995 endometria with similar results.

Bacteriology. Surprisingly few have investigated the bacteriology of the endometrium.

Webb⁵ in the clinic of Bland Sutton inoculated media with material from the uterine cavity of 10 cases at the time of supravaginal hysterectomy for fibromyoma. His results revealed essentially no growths.

Bumm⁷ studied the bacteriology of uterine scrapings and decided that the few bacteria found were not the cause of endometritis.

In 30 cases in which the normal uterus was removed Winter⁸ attempted to secure cultures with material obtained from the endometrial surface by means of a platinum loop. He concluded that the healthy uterine cavity contains no bacteria.

Wertheim⁹ in the days when acute gonorrheal cases were operated upon reported the gonococcus in the uterine secretion in 8 out of 18 cases with undoubted uterine gonorrhea. He believed the uterus second only to the urethra is a favorite seat of gonorrhoea.

Menge⁶ has probably been more deeply interested in the bacteriology of the female genitalia than has any other gynecologist. In the course of his earlier work the uterine cavity of 95 cases was studied; these included both healthy and diseased endometria. Only 4 uncontaminated cases showed infection; the gonococcus was recovered from 2 cases with recent salpingitis and 2 revealed tuberculosis. Menge concluded that the normal uterine mucosa contains no bacteria. The so-called endometritic mucosa contains no bacteria except the gonococcus or tubercle bacillus.

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In his later discussion Menge emphasizes the frequency of chronic gonorrhœa of the uterine fundus. To the gonococcus he ascribes the power not common to other bacteria of passing the internal os without difficulty. He says: "The cervix uteri fails completely in the function of protective organ when the gonococcus is the invading organism." Yet a search of Menge's publication indicates that his belief in chronic gonococcal infection of the body of the uterus is deduced from clinical experience and is not based upon bacteriological evidence.

REMARKS

We see from these contributions to the literature that Hitschmann and Adler have demonstrated monthly cyclic changes in the endometrium. Just how regularly these change occur remains open to argument as does also the claim of these authors that hypertrophy of the endometrium never results from infection. It seems agreed that non-inflammatory pathological processes e.g. abnormal ovarian activity, fibroids (Fig. 2) passive congestion certainly produce excessive development of the endometrium.

In the problem of uterine hæmorrhage the tendency has been to discard the theories of Palmer, Findley and of Theilhaber.² Muscular insufficiency and connective tissue changes are rejected as cause of bleeding; we also find it widely asserted that glandular variations and inflammations of the endometrium never produce hæmorrhage. As a substitute for these rejected older beliefs there is acceptance of the claim of Hitschmann and Adler that mysterious bleeding from the uterus unless caused by tumors or the products of pregnancy is chiefly due to disturbed function of the ovaries produced either by anatomical or purely functional derangement. It would seem advisable to investigate carefully every case of idiopathic uterine

hæmorrhage in order to learn the correctness of this belief.

Bacteriological studies have rarely shown organisms in the uterus except in acute cases. Despite this Menge and others assert that the endometrium is highly susceptible to chronic gonococcal infection.

In further study of the bacteriology of the endometrium it has seemed to me especially desirable to compare histological evidences of chronic inflammation of the endometrium with cultures from the same material. Though we are interested in the frequency with which the endometrium yields histological signs of endometritis after all a problem of more vital clinical importance, whether bacteria live in those tissues which appear altered. We wish to learn whether the presence of mononuclear cells in a given piece of tissue means a possible focal infection of the uterus and we need to know whether such a uterine cavity can be handled with impunity at operation or must be considered a zone of danger from which infection may spread.

Again our foremost authorities make applications to the fundus endometrium in endeavors to cure patients with infectious leucorrhœal discharges. It is desirable to determine whether there is chronic infection in the body of the uterus frequently enough to make such treatments advisable.

MATERIAL AND TECHNIQUE

The present report embraces a series of 118 cases. It has been my object to make a study of the endometrium exclusive of the cervix in all conditions usually encountered except those associated with pregnancy. All material has been secured from uteri removed at operation. Scrapings from the endometrium are so liable to contamination that cultures from them are not included in this series.

The variety of media employed and other procedures followed are in close accord with details described in the bacteriological study of uterine fibroids.³

With sterile instruments and culture material in readiness the stump of the cervix and entire length of the peritoneal surface of the uterus are cauterized and the anterior wall

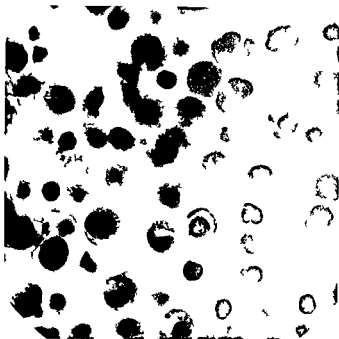


FIG. 1 Extensive plasma cell infiltration seen under high power. Claimed by Hirschman and Adle to be pathognomonic of endometritis.



Fig. 2 Hypertrophic endometrium caused by fibroid. Formerly called hypertrophic endometritis.

bisected. The greater part of the endometrium is excised in its entire thickness down to the muscle layer and is placed in sterile containers to be ground and cultured. The remainder serves for immediate examination for inoculation of culture media with unground tissue and for microscopic study.

This technique affords immeasurably more material than is secured by pipette or platinum loop. Through examination of so much endometrium including the deeper portion it is hoped that the possibility of overlooking dormant infections has been reduced to a minimum.

DETAIL OF CASES STUDIED

In the classification of cases it has seemed best to distinguish between nulliparous and parous patients. Among the latter pregnancy has introduced the possibility of fundus contamination and has also rendered the cervical canal relatively more patent for the ascent of germs into the uterus. Each of these two groups has again been divided into those in which the history has been normal and those with history or operative evidence of pelvic infection. Therefore for convenience in study we have four classes of cases to consider.

Group 1. The endometrium of nullipara without history of infection. In this series of 6 cases fibroid tumors were responsible for hysterectomy in all but a few instances. Gross evidence of inflammation was absent throughout.

No bacteria were obtained from the endometrium and microscopic examination of these cases showed no signs of inflammation.

The material from three patients yielded growth. In the first of these with infiltrating fibroid tumors there were many colonies of long chained non hemolyzing streptococci in cultures of the endometrium. (A similar growth was obtained from the fibroids which were infiltrating in character and picked in the pelvis but did not otherwise suggest the presence of infection.) Microscopic examination of the endometrium of this case was not made.

In another (Case 14) the uterus had been previously curetted with careful technique. The uterine scrapings showed no evidence of inflammation. In cultures made from the endometrium at the time of hysterectomy eight days subsequent to the curettage a varied assortment of bacilli and cocci were



Fig. 3. Endometrium six days before hysterectomy per formed six days later showed a large number of polynuclear neutrophils in cut sections and yielded a rich mixed growth in each culture tube.



Fig. 4. Endometrium six days before hysterectomy per formed six days later showed a large number of polynuclear neutrophils in cut sections and yielded a rich mixed growth in each culture tube.

isolated. Sections through the fundus in contrast with microscopic preparations of the curetted material show very marked cellular infiltration (Fig. 3) in the superficial endometrium; the submucous veins and lymphatics are packed with great number of polynuclear leucocytes (Fig. 4).

The third case presents a similar picture histologically less striking. Curettage (in this instance by another operator) revealed no signs of infection. In contrast the endometrium after complete hysterectomy performed six days later showed a large number of polynuclear neutrophils in cut sections and yielded a rich mixed growth in each culture tube.

Summary. Of 6 supposedly non infected nulliparous cases cultures and tissues were normal in 23. From the endometrium and infiltrating fibroid tumors of 1 case streptococci were isolated. Two cases which had been curetted respectively eight days and six days before hysterectomy showed mixed growth in cultures and histological evidences of endometritis.

Group. *The endometrium of nullipara with history or gross evidence of pelvic infection.* Thirteen cases comprise this group.

Inoculated media remained sterile in 9

cases in which clinical evidence suggested that a gonorrhoeal pelvic infection had died out long before. Three other cases these probably not of gonorrhoeal origin also yielded no growth.

Examination of the histological material from these 13 cases with history of infection but without growth shows a correspondence with the cultures in most instances. One reveals chronic tuberculosis. In another a chronic cellular increase is present but the entire microscopic picture suggests that infection has died out. The next case presents the only example of contrary evidence. In this endometrium are many plasma cells and a good number of scattered polynuclear leucocyte. Despite this gonococci were not obtained. An absence of bacteria in the seropurulent content and ground wall of the fallopian tube reinforces the assumption that we failed to obtain growth from the endometrium of this case because viable bacteria had disappeared from the tissues.

In the only one of this group to yield growth there was a recurrent pelvic infection of sixteen years duration operation revealed an oedematous congested uterus in addition to chronically diseased tubes. Such tissues have been held to be free from living gon

ococci yet the endometrium from the uterus yielded many translucent pearly colonies of gram negative biscuit shaped diplococci. The clinical history lends further weight to the probability that in this case the original infection had remained recurrently active all the sixteen years throughout which the patient suffered from attacks of pelvic trouble. Microscopic examination showed one gland acinus loaded with pus a few polynuclear leucocytes were also found in the stroma and round cells were fairly numerous.

Summary. Of 13 nullipara with history of pelvic infection 1 yielded no growth. Histologically 9 of these were normal 1 showed tuberculosis 1 a slight cellular infiltration and 1 was invaded by polynuclear and plasma cells. The endometrium of 1 case with recurrent infection of sixteen years duration yielded gonococci in cultures and histologic evidence of chronic endometritis.

Group 5. *The endometrium of parous women without history or gross evidence of pelvic infection.* The material from 47 patients was examined. Fibroids were present in half of the cases. Several without fibroids were subject to idiopathic uterine hæmorrhage.

Of the total number 43 revealed no growth. The endometrium of a prolapsed uterus removed by vaginal operation and therefore subject to contamination showed a few colonies of short gram negative bacilli scattered among several tubes of media their presence is ascribed to contamination. There was no histological evidence of inflammation. The results in another case with several colonies of diphtheroid bacilli are also of minor interest for diphtheroid bacilli have been found to contaminate often. Here again microscopic examination shows a normal endometrium.

Through process of elimination therefore but two cases (12 and 26) out of a total of 47 endometria from parous women without history of infection yield growth sufficient to merit further consideration.

One of these (Case 1) subjected to dilatation and exploration preliminary to operation yielded colonies of Doederlein bacilli gram

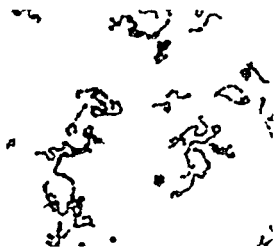


Fig. 5. Anaerobic streptococci obtained in pure culture from the endometrium of a patient with idiopathic uterine hæmorrhage.

negative vaginal bacilli and staphylococci. Upon microscopic examination there was no evidence of endometritis.

The last of this series to yield growth (Case 6) differs from all the others. This patient had not been subjected to intra uterine manipulations since seven years ago when curettage was performed for persistent bleeding which followed spontaneous abortion. Thirteen months previous to hysterectomy menstruation began gradually to increase in amount finally eventuating in almost constant oozing of blood. At operation the uterus was found enlarged but no evidence of infection was noted. The ovaries examined with special care appeared normal in all respects. The endometrium was boggy and thick, fresh preparations showed no bacteria but numerous pus cells. In each anaerobic culture tube there were from 4 to 20 colonies of anaerobic streptococci in pure culture (Fig. 5). On microscopic examination (Fig. 6) enormous numbers of plasma cells and a large number of polynuclear leucocytes were seen throughout the endometrium. The gradual development of hæmorrhage in the presence of anaerobic streptococcus in infection suggests that in this instance infection may be responsible for bleeding from the uterus.

In a microscopic study of the endometrium from the 43 cases of this group without bacterial growth absolutely normal tissues were found in 33.



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d ll i hlt t b tr it th
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Of the 10 remaining a round cell infiltration was evident in 3. These were all hypertrophic uteri the result of pelvic relaxation and congestion with fibroids causing pressure hypertrophy of the endometrium and a large soft organ without evident reason for the enlargement.

Plasma cell in addition to other round cells were seen in 4 cases. One of these was a chronic syphilitic uterus. Another with small fibroid and chronic hypertrophy showed clump of round cells many plasma cells and eosinophils. A cause for infection had not been evident since abortion eighteen years before. In a third case the uterine cavity held an egg sized fibroid polyp. The edematous endometrium contained very many diffusely scattered plasma cells with but few other round cells. The fourth case a large soft uterus with a boggy premenstrual endometrium showed a rich sprinkling of mononuclear cells many were plasma cells. No history of infection was ascertainable.

Finally we come to 3 cases with polynuclear leucocytes. One of these was bleeding one menstruating and one had much free blood in the endometrium. I have been surprised at the frequency with which the

non infected endometrium at the time of menstruation and especially late in menstruation contains polynuclear leucocytes far out of proportion to the red blood cells.

Summary Of 47 parous women supposed not to be infected the endometrium of 2 showed growth. One of these with intra uterine manipulation preliminary to operation yielded a moderate number of colonies in mixed culture and was microscopically normal. The other a victim of persistent uterine hemorrhage showed anaerobic streptococcus infection and microscopic evidence of endometritis. The 45 cases without growth include 3 with slight round cell infiltration 4 with plasma cells (1 of these syphilitic) and 3 with some polynuclear cell increase in the presence of uterine flow.

Group 4 The endometrium of parous patients with history or gross evidence of pelvic infection. Most of the 5 patients in this group had at some time suffered from infection of the tubes and pelvic peritoneum. It should be mentioned at this time that patients in whom infection is thought to be active have not been subjected to operation the few such cases included in this series are examples of recurrent pelvic disease.

Twenty three of these show no growth

TABLE I—INCIDENCE OF BACTERIA IN CULTURES FROM THE GROUND ENDOMETRIUM OBTAINED AFTER HISTERECTOMY

T p e f C	I C	C t h	G r o u p						R e s u l t
			I n t e r m e d i a t e	S t a p h y l o c o c c i	D i p l o c o c c i	D i p t e r i a	B a c t e r i a	M i c r o c o c c i	
N o r m a l	6	3							Th e r e w a s n o i n f e c t i o n
N u l p a r i a	3								O n l y t r a c e s o f i n f e c t i o n
P e r m e a b l e	3	3							M i c r o c o c c i w e r e f o u n d i n t h e d e e p p e l v i c t i s s u e s
P e r m e a b l e	3	9							O n l y t r a c e s o f i n f e c t i o n

Bacteria were obtained from the endometrium 9 times as follows

One case with hemolytic streptococci in cultures had been packed to control hemorrhage two days before operation. Infection presumably resulted from this procedure.

The endometrium of another uterus opened at operation revealed only diptheroid bacilli organisms with a great tendency to contaminate in cultures from this region. Microscopic examination showed a normal endometrium.

Elimination therefore reduces our list to seven cases with infection. Of these five showed gonococci. Three were typical instances of chronic recurrent gonococcal infection with history of first attacks respectively four years fourteen months and seven years before operation. Another was more recent. These four patients were regularly exposed to reinfection. Gonococci were isolated in cultures from the endometrium and from the fallopian tubes of all. Microscopically all showed subacute recurrence of chronic endometritis.

The fifth patient (Case 27) had undergone a right salpingectomy six months before admittance to the service a few weeks later in abdominal sinus developed. Operation revealed that the sinus was continuous with the remaining left tube which was thickened and contained pus. The endometrium was soft pale and on microscopic examination

was found packed with plasma and pus cells. gonococci were numerous in pure cultures from the endometrium and from the tube. It appears that gonococci had been alive and active in the deep pelvic tissues for a period of at least six months without renewal of infection from without.

The history of another patient (Case 5) indicated a pelvic infection of uncertain etiology with onset many years ago. There was found in old inflammation of the tubes and ovaries without exudate but with very firm adhesions involving all pelvic viscera. Each of half a dozen culture tubes contained from one to six colonies of gram positive diplococci. A similar growth was isolated from the fallopian tube. The diplococcus refused to yield characteristics of either staphylococci or streptococci in subcultures. In ascites broth there was slight turbidity with a cloudy sediment in almost transparent growth developed on other media. Large intravenous injections proved non-virulent for rabbits. Microscopic examination of the diseased tube and ovary showed low grade inflammation. there were many clumps of round cells with numerous polymorphous leucocytes. No sections were secured from the endometrium.

The ninth case with growth (Case 11) gave a history of an infected retained placenta twenty three years ago. From that time she suffered from ill health. There was a

TABLE II.—COMPARATIVE BACTERIOLOGY AND HISTOLOGY OF THE ENDOMETRIUM

Type of Case	H 1					Remarks	H 1					Remarks
	N	C	E	M	R		N	C	E	M	R	
N 11	h	d	r	f		P	b	d	f	m		Th
N 11	h	d	r	f		C	h	f	m	b		f
P	h	d	r	f		R	f	d	h	m		h
P	h	d	r	f		T	h	d	m	b		h

pelvic abscess eleven years later also frequently recurrent attacks of pelvic peritonitis after that time the last seven months before operation. Operation revealed a large double hydrosalpinx an inflammatory cyst of the ovary and a greatly hypertrophied uterus. In culture of the endometrium there appeared only one colony of non-haemolyzing streptococci but importance attaches to this because fallopian tube culture contained several similar streptococci colonies. These were non-virulent for rabbit. Histological examination of the endometrium revealed marked infiltration with round cell some of which were plasma cells.

Histological examination of the endometrium from the 13 cases of this group without bacterial growth showed that 10 were microscopically unaltered 13 revealed changes.

Of these 13 culturally normal but histologically altered endometria obtained from parous women with history of pelvic infection two (Cases 15 and 16) showed round cell only. Neither gave history or gross evidence of active infection within recent years.

One case (Case 19) examined under high power revealed a notable (postmenstrual?) polynuclear increase in the lymph and blood

spaces of the endometrium. The only history of infection date back to sixteen years ago when thickening of the tube developed.

Sections from 4 bacteria free endometria contain plasma cell and round cell. Two of the 4 (Cases 15 and 16) give no history of infection for ten years and fifteen years respectively. The other 2 complicated by salpingitis suffered from chronic infection of somewhat more recent date.

Lately 3 endometria without growth (Cases 20 and 21) showed definite endometrial microscopically. One (Case 20) was a severe non-gonorrhoeal pelvic infection of over two year duration with abundant polynuclear leucocyte both in smear and microscopic specimens of the endometrium we were surprised not to obtain growth. Section from the other two cases both complicated by salpingitis showed moderate number of polynuclear leucocyte with abundant round cell but no bacteria in the endometrium or fallopian tube.

Summary. Of parous cases with history of chronic infection 9 showed growth 4 of these regularly exposed to examination yielded gonococci and showed histological subacute endometritis. Another without

exposure for six months had inflammation of the endometrium and fallopian tube with gonococci from both. Two cases of many years standing yielded respectively a diplococcus and a streptococcus both from the endometrium and from the fallopian tube.

Ten endometria without growth proved microscopically normal, contained round cells, a postmenstrual polynuclear infiltration, had plasma and round cells and revealed distinct histological endometritis.

COMMENT AND CONCLUSIONS

From this work I believe that the endometrium of nullipara without history or gross evidence of pelvic infection is almost invariably free from bacteria, it is microscopically normal.

Almost all women who have undergone normal pregnancy with pelvic history otherwise negative likewise pose bacteria-free endometria; the possibility of infection appears to be but slightly increased by pregnancy and the usual change consequent thereto. Microscopic variation from the normal occur in a modest percentage of these cases and are confined chiefly to round cell and slight plasma cell infiltration.

Patients with a history of chronic infection from whose endometrium bacteria are obtainable almost all have alpingitis with equally good growth. *Prometria and ruit exploration of the uterus except the endometrium almost never shows bacteria except when there is infection of adjacent pelvic tissues. Chronic endometritis per se with bacteria present in smears or cultures is practically to be ruled out as a clinical entity.*

The gonococcus is the organism most commonly found. It is difficult to state how long the gonococcus lives in the uterus and tubes because most patients with gonococcal disease are repeatedly subjected to reinfection. In one case it was isolated six months after the patient had last been exposed.

Streptococci and diplococci are less common. They appear to live longer in the tissues than does the gonococcus and apparently can be isolated long after all infection seems to have disappeared.

I would not accept Menge's claim that

the gonococcus possesses a power not common to other bacteria of passing the internal os without difficulty. More likely the gonococcus enters the uterus with the greatest frequency not because of special properties which it possesses but because it is the infectious organism most often brought into contact with the cervix.

Hitschmann and Adler claim that plasma cells are pathognomonic of inflammation; that their presence always means inflammation and their disappearance signifies cessation of it. Plasma cells denote inflammation in its broadest sense but they are not regularly coincident with bacteria. Moreover I have found plasma cells present in edema of the endometrium when all other evidence indicated that inflammation did not exist.

Significance attaches not only to the presence of plasma cells but also to infiltration with other mononuclear cells. The tendency is entirely to disregard these because it is held that mononuclear cell infiltration can not be distinguished from normal lymphocytes. Observation reveals that this is erroneous. Lymph follicles and more diffusely distributed normal lymphocytes are arranged with some regularity. Mononuclear cell infiltration on the contrary are irregularly placed in groups and richly scattered throughout.

In my experience the microscopic evidences of endometritis coincide quite well with cultural results. The bacteria disappear first followed in turn by the polynuclear leukocyte plasma cells and other mononuclear cells in order named. Bacteria have seldom been found unless there is infiltration with polynuclear leukocytes in addition to plasma and round cell (Fig. 7). It must be admitted that future improvements in cultural methods may yield bacteria from endometria with only mononuclear cell infiltration. In any event mononuclear cells are indicative of lesser degree of tissue reaction and suggest that infection may be lurking in adjacent organs.

Hitschmann and Adler derive much credit for demonstrating physiological cyclic change in the endometrium but it is unfortunate that they claim inflammatory

hyperplasia does not occur. Tissues possess an inherent tendency to hyperplasia under the stimulus of inflammation and there is no evident reason why the endometrium should be an exception to this rule. Histological study with due regard for cyclic change I believe points toward the existence of true inflammatory hyperplastic endometritis.

Again should we agree that inflammation never produces uterine bleeding? Surely it is uncommon but we find occasions as in the above reported case of anaerobic streptococcus infection where inflammation of the endometrium is presumably the direct cause of hemorrhage.

Clinical considerations. Several points of clinical importance come up in this work.

We may first consider infection of the endometrium consequent to curettage. In certain cases normal scrapings have been obtained from the uterus then several days thereafter in the endometrium secured by hysterectomy mixed cultures and endometritis have been found. Infection is perhaps not a customary result of curettage but it appears not uncommon. This has called my attention to the fact that preparation for instrumentation of the uterine cavity does not ordinarily include cleansing of the cervical canal. Yet this tissue is freely accessible to all vaginal flora. I believe it a wise precaution to gently introduce an iodine applicator as far into the cervix as it is patulous before attempting to pass instruments.

Some will wonder if curettage tends to contaminate the endometrium when infection does not complicate hysterectomy in patients with preliminary curettage. Fortunately nature can dispose of a few bacteria at the time they are introduced. But patients not operated upon until several days later when the bacteria have had time to multiply I believe are not ideal subjects. The problem is in miniature that which confronts the abortionist: he can meddle once with com-

parative safety — but if tempted to interfere again to complete the task he works in a contaminated and dangerous field.

A minor problem is concerned with the ideal time to select for operation. At the close of menstruation there persists a polynuclear leucocytosis. It would seem desirable other conditions being equal to choose this time for operation when these protective leucocytes are available for aid in convalescence.

A point of some interest involves the possible infectiousness of the lining of the uterus. At the time of hysterotomy or of subtotal hysterectomy it is requisite that we know whether the endometrium can be handled with impunity. In response to this question it appears that if the tubes and other pelvic viscera are healthy spread of infection from the endometrium need not be feared. Exception to this rule must be made in case of pyometra or if the uterus has been recently explored.

Next comes the problem of intra uterine therapy. We have found that chronic infection of the corpus uteri speaks for almost certain involvement of other pelvic organs. Intra uterine applications are therefore of little avail for the most important focus of infection is well beyond their reach. Again in the absence of bacteria it may be desired to rid the patient of a persistent discharge. Study of this question makes it appear that mucus secreted from the body of the uterus is in very small amount and limited mostly to the premenstrual period. In the cervix are glands prolific in activity especially adapted to mucus secretion. It is here in the cervix up to the level of the internal os that we will do best to look for infection and it is against discharge from the cervix that treatment can be efficiently directed.

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m t l h l b b t d th h th k d f
D E C D d j

COLON BACILLUS INFECTION, EXTRAGENITAL, COMPLICATING PREGNANCY AND THE PUERPERAL STATE

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OF late years obstetricians have given considerable attention to infection of the kidney by the colon bacillus complicating pregnancy. Its pathology, symptomatology, diagnosis and treatment are familiar topics. We advance but one phase of this subject in this paper.

It is recognized that in the great majority of these cases treatment by rest in bed with the patient lying upon the right side or upon the left side as the symptoms indicate with a limited diet and abundant use of water and with drugs which act as antiseptics to the mucous membrane of the urinary tract are quite sufficient.

When these remedies fail local treatment of pyelitis by catheterization of the ureters draining the pelvis of the kidney and washing it out with antiseptic solutions is often successful.

Opinions have differed concerning the efficiency of treatment by vaccine in these patients. It is recognized that resistance to the colon bacillus is not readily estimated by the opsonic index but as a clinical fact the colon bacillus readily attacks the pelvis of the kidney in patients whose general power of resistance is lowered by overwork, underfeeding, illness, pregnancy or acute intestinal disturbances. Vaccine treatment of these cases may benefit the symptoms but as a rule does not cure the condition. This probably results from the fact that the lesion is chiefly of the mucous membrane of the pelvis of the kidney and not of the kidney tissue itself. In experiments to determine the value of vaccines Crabtree and Cabot¹ found that the immunity conferred by the colon vaccine was of short duration and that while vaccine influences the symptoms it does not materially control the lesion present.

Danforth² reviews the modern literature

of the subject thoroughly and reports a case favorably influenced by ureteral catheterization which showed the influence of pressure upon the right ureter. The ureteral catheter was stopped before it entered the pelvis of the kidney while the patient was lying upon the back or right side but when the patient was turned upon the left side so that the uterus gravitated away from the ureter the catheter passed without the slightest difficulty. Danforth made studies to determine the relation existing between the bacteria present in the bladders of normal pregnant women and the pyelitis of pregnancy. In this urine taken under careful antiseptic precautions staphylococcus of low virulence and occasionally the colon bacillus were found but there was no evidence that the colon bacillus from the bladder gained access to the pelvis of the kidney by ascending through the ureter. Danforth with a great many others believes that the infection is carried by the blood.

The writer has been especially interested in a series of cases in which medical treatment failed. In these cases the infection was severe and could be traced to the right kidney and the operation of nephrotomy with drainage was successfully employed. He has reported three cases of this procedure without the interruption of pregnancy and with a successful issue for mother and child and adds to this a fourth.

The patient a multipara, dark brunette, aged 29 years was admitted to the Maternity Department of the Jefferson Hospital in the seventh month of her fourth pregnancy. She had been ill for an indefinite time with a history of fever, pain in the back and general malaise which had been mistaken for rheumatism. On examination she was fairly nourished but showed by her lassitude the effect of fever. She gave a history of having had chills and fever for about 10 days before admission. There was no history pointing to the toxæmia of pregnancy nor was there evidence of specific infection. Soon after admission the patient had a severe chill the temperature rising to 103.5 F and then dropping

to 97 F. This was succeeded on the following day by another chill, the temperature rising considerably above 106 F and dropping to 99 F. A third chill followed with a much lessened variation in pulse and temperature. During the evening chills the pulse was 130 the average being 120.

On examining the patient's abdomen the intestines were found to be moderately distended with gas. There was no tenderness over the uterus nor over the region of the appendix but deep pressure over the right kidney gave decided pain. This pain radiated along the course of the ureter. The urine obtained by catheter gave a pure culture of colon bacillus in great abundance. The patient had a leucocytosis of over 20,000. There had been considerable disturbance of digestion but there was no evidence of appendicitis or peritonitis.

The patient was first treated by rest in bed, turning upon the left side, milk diet with abundance of water, uterine and saline purgatives but without result. The temperature continued high with frequent chills.

The operation was done by turning the patient upon the left side under ether and oxygen anesthesia and exposing the kidney by an incision parallel to the course of the twelfth rib. It was difficult to come upon the kidney for the uterus was suitably large to press it up beneath the ribs and the patient's abdomen was not as long as it sometimes been. When the kidney was reached it was seen to be considerably enlarged and greatly congested. An attempt was made to anchor the kidney in the wound by passing a chromicized catgut suture through the edge of the wound and thence through the cortex of the kidney and out upon the other side of the wound. Although the suture was passed without difficulty it could not be used to anchor the kidney for the substance was so soft that the suture tore through. Accordingly gauze was packed about the kidney and an opening made over the cecum border and the glued finger passed readily up to the pelvis of the kidney. Bloody urine escaped in considerable quantity. The kidney was then drained by passing a straight ligature into the pelvis and bringing it out through the wound. The kidney was fixed by packing gauze around it and the wound partly closed leaving a point for the drainage. For twenty hours after operation the patient's temperature had fallen to normal with corresponding improvement in the pulse and general condition. She steadily improved and went home under the care of her family physician with her wound almost healed. There was no interruption on the pregnancy and fetal movement were plain and fetal heart sound distinctly heard when the patient left the hospital.

We do not believe that all cases of pyelitis of pregnancy require nephrotomy but our experience has caused us to consider nephrotomy and drainage as a prompt and successful method of relief in severe cases.

The induction of labor is advocated by some and the logic of this course of action would be that the colon bacillus infection was the principle condition of which pregnancy was a complication. Therefore by ending pregnancy one should expect to cure or greatly limit the colon bacillus infection. This does not seem reasonable to us for the colon bacillus infection is the complication to pregnancy and by the free drainage of the affected area the infection clears up without interrupting the pregnancy.

We have been especially interested in cases in which infection by the colon bacillus attacking the appendix, the colon and surrounding tissue has complicated pregnancy or the puerperal state. The symptoms of this condition are often obscure and the diagnosis may not be easy. In pregnancy the symptoms are those of appendicitis with a wider extent of tenderness over the colon. It may be difficult to determine whether the appendix or the right kidney is at fault although it is rare to find both infected at the same time. An exact diagnosis between appendicitis, colon bacillus infection of the right kidney or salpingitis may be impossible before the abdomen is opened.

The symptoms usually seen in appendicitis in women are those observed in these cases. Vomiting may not be so significant in view of the fact that many pregnant women vomit in the early months. Leucocytosis, tenderness, beginning paresis of the intestine without signs of active peritonitis point strongly to colon bacillus infection. The treatment is section with removal of the appendix followed by the use of free drainage if indicated.

In some of these cases not only is appendicitis present but also a pathological condition in the ovary or tube which obscures diagnosis.

The recently operated upon multipara, otherwise sound and healthy in the fourth month of her third pregnancy, complained of a deep pain in the right lower abdomen with a sensation of discomfort extending down to the pelvic brim and with considerable nausea and disturbance of the stomach. On section a small ovarian cyst was found wedged into the pelvic brim beside the growing uterus and an adherent and chronically infected appendix pushed down to the pelvic brim. The removal of these as followed by the patient's prompt relief.

from her symptoms without the interruption of pregnancy.

When colon bacillus infection occurs in puerperal patients the first suspicion is naturally that of puerperal septic infection. If a clear history can be obtained concerning the management of the labor and any complications which may have occurred at labor the diagnosis becomes much simpler. There are diagnostic points of interest which can be readily appreciated. In colon bacillus infection complicating the puerperal state the lochial discharge is not suppressed or altered, the secretion of milk is but little if at all influenced and the cardinal signs of septic infection are wanting. There is no active general peritonitis, the abdomen is moderately distended, the condition resembles somewhat that of ovarian tumor with twisted pedicle. In some of these cases the infection has undoubtedly retarded delivery for there is a history of malaise with indefinite abdominal pain before delivery. The character of the labor seems to have had no influence in the development of the infection. If the child has been nursed it is surprisingly little affected by the mother's condition if it be allowed to continue to nurse.

A primipara fairly nourished gave birth to a full term child in spontaneous labor in the Maternity Department of the Jefferson Hospital. Slight laceration occurred which was immediately repaired and healed normally. The secretion of milk developed and the child nursed. Signs of abdominal infection developed later than is usual in puerperal sepsis and consisted in moderate abdominal distention with pain in the lower abdomen generally diffused and with tenderness on deep pressure over the head of the colon. There was considerable leucocytosis but the urine was practically normal. The temperature ranged between 102.5 and 99.5 F and the pulse rate corresponded. The Widal test was negative and there was no evidence of septic disease. No pulmonary or cardiac condition could be found to account for the symptoms. On the twelfth day of the puerperal period the abdomen was opened, the lochial discharge having practically ceased. The uterus, tubes and ovaries were normal, involution had progressed fairly but the colon and abdominal peritoneum presented a very interesting appearance. Although there was no exudate upon the peritoneum it was bright red and the lymphatics could be traced in lines of red. The colon was reddened, distended throughout its entire length and beneath the peri-

toneal coat could be seen areas of infection varying in size from a dime to a quarter dollar. These ulcers seemed to be covered with a yellowish gray exudate. The appendix was below the brim of the pelvis and surrounded by adhesions. It was brought up with some difficulty and found to be swollen and red, denuded and at its tip a small point of rupture although no abscess had developed. It was removed, recent adhesions liberated and a large gauze bag carried to the bottom of the pelvic cavity and distended with strips of iodoform gauze. The patient was placed in Fowler's position and salt solution given by rectum. Her recovery was prolonged by the gradual closure of the abdomen at the point of drainage but her symptoms were immediately relieved and the pulse and temperature soon became normal.

A Turkish woman admitted to the Maternity practically in labor. A few hours after admission she was delivered in a spontaneous normal labor of a healthy male child with very slight laceration which was immediately closed. Forty-eight hours after labor her temperature rose to 104 F and immediately dropped to 99. This was followed by further rise until the temperature on two occasions reached 103.5 F. The pulse varied from 120 to 140. The secretion of milk became established naturally. The abdomen was moderately distended, slightly tense and with tenderness on deep pressure in the right lower abdomen. The lochial discharge was normal and although the stitches were immediately removed from the lacerated surface in the pelvic floor the tissues were found clean and healing. On opening the abdomen the peritoneum was universally reddened but there was no exudate. The uterus, tubes and left ovary were normal while a small cyst had developed over a portion of the right ovary. Its pedicle was not twisted. The appendix was high up almost beneath the liver and buried in a mass of adhesions. It was liberated with difficulty and removed and found to contain blood and pus without rupture. The patient was treated by drainage free use of saline with stimulation but she died of an overwhelming toxemia 48 hours after operation. Autopsy could not be obtained.

A Greek woman multipara was delivered spontaneously of a female child in breech presentation. Old lacerations were present. The patient's temperature remained practically normal, the pulse varied considerably, the respiration was normal but leucocytosis of 5,000 developed. The abdomen was not distended, moderately soft. There was indefinite general tenderness and distinct tenderness on deep pressure in the right lower abdomen. The urine was normal, the Widal test negative and there was no evidence of syphilis. From the high leucocytosis with normal urine the indefinite tenderness, malaise and absence of symptoms of puerperal septic infection it was believed that the patient had a colon bacillus infection complicating the puerperal state. At operation the colon was reddened moderately, dis-

tended and the peritoneum was reddened. There was an unusual quantity of dark colored serum in the abdominal cavity and considerable inflammation about the head of the colon. The appendix was bound down by adhesions but had not ruptured. It was removed and the abdominal viscera palpated to determine the condition of the kidneys and gall bladder. The kidneys were found to be normal in size and in normal position. The gall bladder contained a moderate quantity of bile and no gall stones could be felt. The patient gave no history of a pathological condition of the gall bladder. The method of treatment by gauze drainage and salt solution was followed out in this case and the patient made an uninterrupted recovery and subsequently resumed the nursing of her child. Examination of the tissues removed showed the presence of abundant colon bacilli in pure culture.

It is the observation of the writer that these cases differ from appendicitis in the non-pregnant woman. In the latter while there may be peritonitis or infection in the surrounding tissues binding down the appendix, the remainder of the colon shows no signs of infection. In pregnant and puerperal patients however the entire colon is distinctly reddened, moderately filled with gas and in the first case narrated, colonic ulcers were very distinct. These patients gave no history of having had acute appendicitis but stated that they had had vague abdominal pain during pregnancy. The characteristic history of vomiting could not be obtained. These cases had spontaneous labor, lactation became normally established, the lochial discharge was not suppressed. No attempt was made to use a colon bacillus vaccine as the experi-

ence of the writer in pregnant cases thus complicated had not been satisfactory.

Obstetricians are familiar with the fact that pregnant women are especially prone to appendicitis and cholecystitis. In the cases narrated no history could be found pointing to cholecystitis while examination during operation failed to reveal evidences of this condition nor was there reason to believe that gall stones were present. The usual symptoms of colon bacillus infection of the right kidney were absent and in each case operation confirmed the provisional diagnosis.

It is especially important for the welfare of pregnant women and their children that colon bacillus infection be promptly recognized and thoroughly treated. The dangers of appendicitis in the pregnant woman far exceed those of the non-pregnant and while a patient during pregnancy may escape apparent injury from cholecystitis, an infected gall bladder rarely recovers after pregnancy without drainage. In the puerperal period it must have happened that cases of this condition were confused with puerperal septic infection located in the genital tract and were so regarded and treated. There is no evidence that this condition affects the infant and it seems remarkable that the secretion of milk is so slightly retarded. Ready confirmation of the diagnosis of colon bacillus infection was offered by microscopic and bacteriological examination of the appendices removed and of the serum taken from the abdominal cavity.

RIDER'S TENDON

RUPTURE OF THE ADDUCTOR TENDONS OF THE THIGH

By WILSON T. DAVIDSON, M.D.

Assistant Clinical Medical Professor, U.S.A.M.

RUPTURE of tendon in the human body is not such an infrequent occurrence as one would at first suppose. In order of their frequency come those of the calcaneus, Achilles, the quadriceps extensor, the triceps and the biceps of the arm

and the rectus abdominis. The rupture may take place at any one of four points: viz. in the muscle substance itself, at the juncture of muscle and tendon in tendon and at insertion of tendon to bone. In certain cases it is interesting to note that upon the forcible

contraction of muscle, particularly in the young and athletic the bone gives way and a small fragment is torn off at the point of insertion of the muscle as for example the tip of the olecranon in the forcible contraction of the triceps

It is worth while to study the exact manner in which rupture of the adductor tendons of the thigh is brought about at mounted drill or exercise One may first consider the rider properly seated as a cavalryman say at mounted inspection

The buttocks bearing equally upon and well forward in the middle of the saddle

The thighs turned without constraint upon their flat side clasp the horse evenly and stretched only by their own weight and that of the lower legs

The knees bent and flexible

The lower legs falling naturally the calves in contact with the horse without pressure the toes dropping naturally when the trooper is without stirrups

The back supple and never hollowed

The upper part of the body easy free and erect

The shoulders thrown back evenly

The arms free the elbows falling naturally

The head erect and turned to the front but with out stiffness

Eyes alert well up and directed to the trooper's front (1)

But just as soon as the trooper begins to move forward other muscles are brought into play particularly the adductors The exercise of "posting" serves especially to develop the adductors and since these muscles are brought almost constantly into play in the exercise of riding they are markedly developed in a well drilled cavalryman who proudly refers to them as the 'cords' in his legs In the exercise of the broad and the high jump rearing up jumping to one side bucking and in fact all movements of the horse that require efforts on the part of the rider to keep his seat the adductors are brought powerfully into play in grasping the sides of the horse So long as the rider is able to keep his seat secure all goes well there is not the slightest danger of a tear or rupture of the muscles But as frequently happens in the case of a young soldier the rider and the horse do not know each other The horse does not understand the various movements made by the rider and may become frightened by them

the rider perhaps feels ill at ease or frightened and this feeling is transmitted to the horse And, moreover if there happens to be an ill fitting saddle the rider is at an additional disadvantage in keeping his seat An ancient writer refers to this injury as resulting from

an evil horse

In a naughtie saddle (2)

Under the conditions just mentioned the horse makes a sudden plunge as in bucking or a high jump and at the same time the rider becomes frightened and fails to maintain a firm seat by means of the adductor tendons The result is that he is toppled forward and to one side the tense adductor tendon is thrown forcibly against the pommel of the saddle and by this impact is strained, broken or torn loose from its insertion

Not all ruptures of these tendons however, are due to riding The following is a case in point

Patient admitted to Providence Hospital Washington February 7 1891 suffering from tumor upper and inner aspect of right thigh Had been an enlisted man in U S Army

History of complaint Two years before upon an alarm of fire being sounded ran down a steep flight of winding stairs and slipped and fell with his thigh in a position of extreme extension Suffered intense pain and was in bed several days Shortly after this he noticed tumor on upper and inner aspect of thigh The tumor which increased in size incapacitated him for duty He was discharged by examining board for physical disability Records of Adjutant General's Office show

Pvt W L M Batt B 1st U S Artillery discharged at Fort Columbus N Y H August 12 1890 Cause of disability tumor on inner and upper aspect of right thigh (3)

Abbe reports a case of rupture of the adductor longus The patient while riding had been thrown on the pommel of his saddle striking the inner and upper part of the thigh making a large extravasation A fluctuating mass was found below the pubes on the inner aspect of the thigh which when he attempted to adduct the leg immediately bunched itself into a hard mass It was the adductor longus muscle which had been torn away from the femur and on contraction drew up toward its pubic attachment When Dr Abbe saw the patient he was suffering no inconvenience and nothing was done (4)

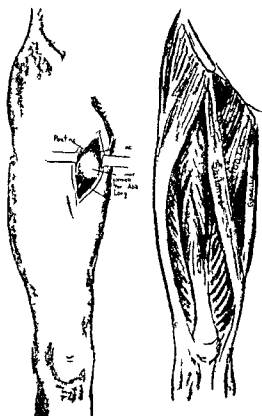


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The two cases observed by the writer were both incurred in a manner identical with the one reported above

CASE 1 Pvt I P Troop H 3th Cavalry age 3 service 11 months

History of complaint Soldier was riding at recruit drill when horse became frightened and made a sudden plunge to one side. He was thrown up against the pommel of the saddle the upper and inner portion of the right thigh striking the soldier felt something snap experienced severe pain suddenly became faint and fell from his horse. The next day he noticed a bulging on upper and inner aspect of right thigh. Was in camp infirmary at Columbus New Mexico for 10 days when he was sent to dismounted duty. Later on he did mounted duty. In July 1913 leg began to pain him and caused considerable trouble at mounted exercise and he was admitted July 19 to the base hospital at Ft Bliss.

Physical examination Upon the contraction of the adductor tendons of the right thigh a tumor



Fig 3 (t l f) App f t m f m f nt
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 Fig 3 A oth w th till firm t t f
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forms on its upper and inner aspect and when the muscles are relaxed the tumor disappears almost entirely. Upon palpation it is firm and slightly painful. Under ether anesthesia a five inch incision was made directly over the tumor in the direction of the fibers of the adductor tendons. During the subcutaneous fascia the adductor longus was encountered between the pectineus and gracilis (Fig 1). It had been to a loose form on the lower two thirds of its insertion the remaining upper third being firmly attached to the bone. The torn portion as excised the fascia overlapped and the wound closed. Recovery uneventful. Duty August 14 condition on discharge good.

CASE 2 Pvt J S K Troop K 14th Cavalry age 24 service 5 months

History of present complaint While at cavalry drill near Laredo Texas was jumping hurdle had to jump without stirrups over hurdle without any difficulty but striking the ground on the other side of the hurdle struck the pommel of saddle with left leg. The moment he did this he meditated to have lost all strength and fell from saddle at once to ground. The patient continued for about two lay could not walk for 8 days then he began to walk slowly. Did not notice any swelling as returned to duty. At that time troop was in field at Del Es Texas. During extended gallop drill one morning about one week after and in line of skirmish soldier was at head of line when he pulled his horse back. Horse stopped rather short and then he came up against the pommel of saddle this hurt his leg again. About an hour after noticed a bulging in leg. From that time on his leg always bothered him. The bulging was swelling in leg about 8 weeks ago. Did not bother him much at first after it became larger and then it did bother him. The lump could form and disappear when he could ride at a trot or have to grip the horse.

Admitted to Camp Hospital August

Physical examination Muscular tumor upper and inner aspect left thigh made more prominent by contraction of adductor tendons (see Figs 2 and 3)

Under ether anesthesia a four inch incision was made directly over the mass in the direction of the adductors. Opening the fascia the adductor brevis was found torn loose from its insertion all except a small strand the size of one's little finger at the upper portion. The torn muscle had contracted bringing the end up into the central portion of the wound. The muscle was excised completely and the fascia overlapped slightly. During convalescence the patient complained of a drawing sensation upon abduction of thigh at upper third of wound under local anesthesia the deep fascia was found adherent to upper portion of scar. A small strip of the fascia was excised and further recovery was uneventful. Soldier was in hospital six weeks and since that time has been doing full duty continuously with his troop.

TREATMENT

In the treatment of the three first mentioned classes of rupture of muscle in tendon in muscle substance and at juncture of muscle and tendon the parts should be exposed and brought together with strong mattress sutures and the overlying fascia carefully united so that there may not be a partial loss of function from adhesions. Applying this method of treatment to the two cases just mentioned one would secure the torn end of the muscle and anchor it to the proper line of insertion. Unfortunately this would not be easy to accomplish and it is doubtful that one would get a union sufficiently firm for good function within a reasonable length of time. Suturing the torn end to an adjoining muscle might be tried as for example in Case 1 to the gracilis in Case 2 to the adductor longus. However in the two cases operated upon by excision the result left nothing to be desired the soldiers did full duty the remaining adductors seem to have taken up the entire function of the lost muscle.

SUMMARY

1. Rider's tendon is caused by failure to keep seat properly after sudden stopping bucking jumping or rearing up of horse. Thus the adductor muscle is thrown against the pommel of the saddle making an impact like striking the trout string of a bow.

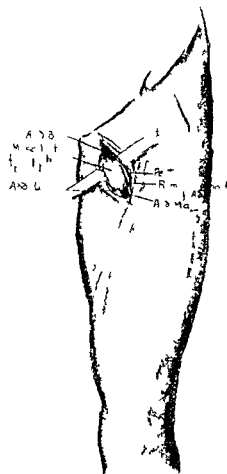


Fig. 4. Drawing showing appearance of parts after incision of deep fascia and retraction skin. Note the small remaining portion of adductor still attached to femur. (Drawing by Professor William Keiller from sketch furnished by author.)

2. It usually does not cause sufficient disability to demand operation until some months after the injury.

3. Where the muscle is torn loose from its insertion treatment by excision of the torn portion is the method of choice.

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EXPERIMENTAL PHYSIOLOGICAL ACTION OF OVARIAN EXTRACTS

By DR. GUILLERMO P. GONALONS, BUENOS AIRES, ARGENTINE REPUBLIC
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THE influence of ovarian extracts upon the circulation was investigated for the first time by Federoff in 1899 who found that in rabbits the extracts produced a slowing of the heart and an elevation of arterial pressure. Ch. Livon (1898) placed them among the hypotensive glands as a conclusion of animal experiments. Vincent and Sheen (1903), Patta (1907), Hallion (1907) confirmed this last conclusion. Hallion produced hypotension accompanied by diminution of volume of the kidney and of the nasal mucus and an increase in the thyroid volume. He considered this thyroid vasodilatation as a specific action of ovarian extract. Patta found that double vagotomy did not prevent hypotension. Busquet and Pachon found that there was hypotension even with prior atropinization.

Below differentiated between the action of the corpus luteum and ovary and found that the first in small doses caused a fall in pressure, diminution in the number of pulsations, strengthening of cardiac contractions and increase in arterial tonus. In large doses it caused marked hypotension, increase in frequency of pulsations and diminution in the amplitude of the cardiac contractions. Ovarian substance caused hypotension and diminution of the pulse. Biedl could not confirm these results; he found that ovarian extract had a hypertensive action due to a mixture with adrenalin and lutein extract in small doses was inactive and in large doses produced intravascular coagulation. He noted that all the hypotensive effects described are shown by organic extracts which accelerate coagulation in the ovary as in others and that such effects were not specific.

Schuckele found that the action of extracts of the ovary and of the corpus luteum was variable and that they sometimes produced intravenous hypotension and at other times a slight hypertension. The juice expressed from these organs under high pressure

centrifuged and filtered caused a very strong very durable hypotension and repeated injections of such extracts caused lesser descents in pressure which could be kept below normal during several hours. This action was not influenced by atropin and injection of thyroid and thymus extracts increased the hypotensive action. Adrenalin injected before or conjointly with these had an inhibitory action on the hypotension and hypophyseal extract had a similar effect but while it impeded elevation of tension it did not produce bradycardia. Schuckele thinks that the hypotension is due to vasodilatation of the peripheral and abdominal vessels. A drop of extract clearly caused conjunctival hyperæmia. The antagonistic action of barium chloride proves that the action is upon the vascular musculature. He says that small doses have no action upon the respiration, heart and nervous system but that large doses cause bradycardia, convulsions, depression and death of the animal and that such doses cause contractions of the intestine and bladder as well as excretory excitation of the lachrymal and salivary glands. Coagulation of the blood was retarded. Moreover, he thinks that the substance which produces these effects is a product of the internal secretion of the ovary which is met in the immature graafian follicles and in the corpus luteum. Biedl made controls of Schuckele's experiments and from his own experiments with ovarian, uterine and placental extracts concluded that there is no such specific substance and that the toxic picture is the same as is produced when any other extracts are injected intravenously. His pupil O. Fellner prevented death in the animal by hirudin injections.

Champy and Gley have made separate experiments of the action of the ovary (with out the corpus luteum) and of the corpus luteum of cows, ewe, mares, rabbits, sows, bitches and women; they were triturated

with sand and macerated in twenty times their weight of salt water for thirty minutes centrifuged filtered and injected into dogs. Ovarian extract of cows pregnant or not caused a strong fall in arterial pressure (50 to 90 millimeters of mercury) which was followed usually by visomotor undulations commencing when the pressure rose. These are very easily produced by gravid bovine extract. With small doses the descent is less marked and of much shorter duration.

Ovarian extracts from the ewe and mare are inactive; those from a gravid mare produce hypotension (0 to 40 millimeters of mercury) of short duration.

Rabbit ovarian extract with or without corpus luteum provokes a hypotension in rabbits (30 to 60 millimeters) at times with cardiac irregularities followed by visomotor undulations.

Ovarian extracts from the sow are very toxic producing strong hypotension (80 to 100 millimeters mercury) with cardiac debility and sometimes with respiratory disturbance which leads to death.

Ovarian extract from the bitch produces slight depression (0 millimeters) of slight duration. Human ovarian extract produces transitory depression without any great cardiac modifications (9 experiments in all).

Periodic corpus luteum extract from the cow produces only a slight diminution of arterial pressure about 20 millimeters mercury. Once there was a fall of 50 millimeters with weakness of cardiac contractions. Ex-

tract of corpus luteum of pregnancy was on the contrary very hypotensive and diminished the amplitude of the cardiac pulsations. With larger doses the heart is much weakened the respiration is checked and the animal dies. Repeated injections are inactive; there is rapid immunity even against toxic doses. Periodic corpus luteum extract also gives this protection. Periodic corpus luteum extracts of the ewe are inactive (weak doses?). Extract of corpus luteum of the mare is weakly hypotensive. Extract of corpus luteum of the sow causes phenomena similar to those of ovarian extract of the same animal. I have never seen respiratory failure. During the hypotension there is a phase of bradycardia. Sometimes there is rapid immunity. Extracts of corpus luteum in regression (corpora albicans) of the sow and cow show the same activity as the periodic. Follicular fluids are inactive.

In the description which follows we give our personal results. Only in matters where we have not experimented will we mention other authors.

We have used macerated decoctions and extracts in different solvents: alcohol, chloroform, ether of ovaries without corpus luteum.



Fig 1

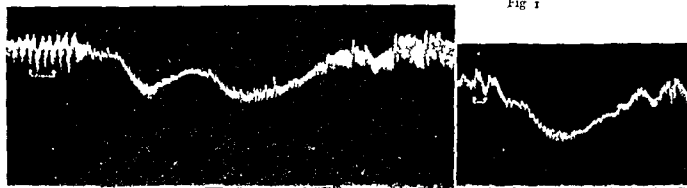


Fig. (at left) Arterial pressure chart made from 14 kilogram chloralid after injection (between arrows) of 10 cubic centimeters of etheric extract of gravid corpus luteum. Time in seconds.

Fig 3. Arterial pressure after injection (between arrows) of 10 cubic centimeters of chloroform extract of gravid corpus luteum. Chloroform weight 1 kilogram. Time in seconds.

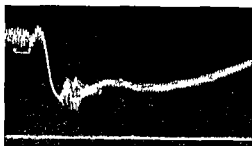
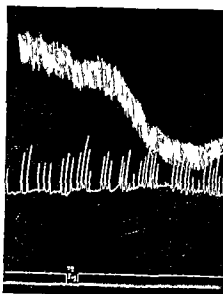


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bodies and of the corpus luteum of the cow
and from animals of 1, 2, and 3 years.

I have personally collected the ovaries
in slaughter houses in order to be sure whether
there was pregnancy or not. They were
used as quickly as possible in some cases in
3 to 4 hours in others within 1 hour in
the latter instance being preserved in a
refrigerator at 0°C or frozen. We have
found that there is attenuation of the ac-
tivity with time but this is much greater and
more rapid in solutions than in the preserved
organs so that it is necessary to use the solu-
tion within a short time after preparation.

Maceration was effected with physiological



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solution or Ringer's the fluid 14 or 15
triturate 1 macerated during half to one hour
and then filtered through cotton. Macerated
corpus luteum yield an orange color. We
have observed that with distilled water the
maceration gives the same action.

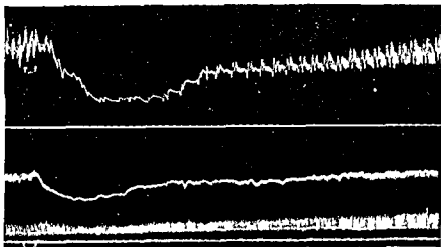


Fig 5 (b) C t d p j c t (b t) f b t m t
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Fig 6 C t d p e p m g m f t j t (b t) f b
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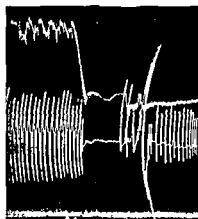


Fig 8

Fig 8 Carotid pressure pneumogram after injection (between arrows) of 12 cubic centimeters of decoction of gravid ovary 25 per cent Chloralised dog weight 9000 grams Time in second

Fig 9 Carotid pressure pneumogram after injection (between arrows) of 6 cubic centimeters of decoction of

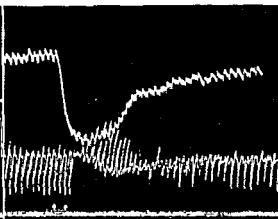


Fig 9

gravid ovary 5 per cent Chloralised dog weight 9 kilograms Time in second

Fig 10 Carotid pressure pneumogram after injection (between arrows) of 6 cubic centimeters of macerated periodic ovary of cow 25 per cent Chloralised dog weight 10 kilograms Time in second

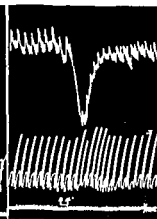


Fig 10

Decoctions with the same solvents and the same substances are made by boiling 10 or 5 minutes decoction of corpus luteum gives a lemon yellow color that of the ovary is milky

We report that all extracts ought to be used at once because they completely change macerations more so than the decoctions

We can say nothing concerning the substances which give these extracts their physiologic properties Dialysis gives inactive results both with decoctions at 100 per cent and with aqueous solution in the dialyser (Fig 1)

Treating a decoction of gravid corpus luteum at 15 the action of which on the pressure we have proved with phosphotungstic acid and eliminating excess with baryta and sulphuric acid and then neutralizing the liquid remains inactive Clarifying with subacetate of lead eliminating the excess with sulphuric acid and neutralizing the liquid remains inactive Precipitating with warm acetic acid it shows only an insignificant hypotensive action It seems therefore that the active substance or substances are neither dialysable nor do they possess the properties of basic substances of small molecules like the active principles of the suprarenals and hypophysis (Housley)

Etheric chloroformic and alcoholic ovarian extracts evaporated and totally emulsified in physiological solution do not modify the arterial pressure

Etheric extracts of gravid corpus luteum show a hypotensive action which is maintained for a long time (Fig)

Strong doses of chloroformic and alcoholic extracts evaporated and emulsified in physiological solution show a hypotension of 6 millimeters of mercury for chloroformic and 1 millimeters for alcoholic (Fig 3)

Gravid corpus luteum carefully cleared of fat repeatedly with ether chloroform sulphide of carbon benzene alcohol at 100 in decoction of 13 produces the same typical hypotensive effect as a fresh decoction (Fig 4)

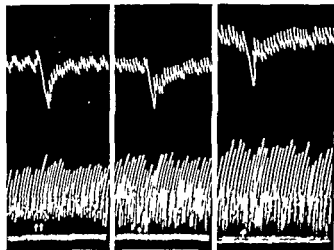
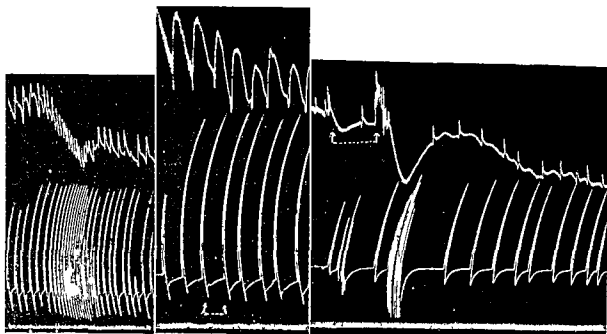


Fig 11 Carotid pressure pneumogram a (at left) After injection (in heated artery) of 6 cubic centimeters of macerated cow ovary 5 per cent b after second injection of 6 cubic centimeters c after third injection of the same maceration Chloralised dog weight 9 kilograms Time in second



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Therefore if there are hypotensive soluble elements in the solvents of the fats the true active hypotension producing substance of the extracts is insoluble in them

The tracings of arterial pressure have been made in chloralized dogs and the arterial pressure was taken by the mercurial manometer and in some cases we have at the same time taken the respiration with Marey's drum apparatus

We have obtained the same results both with the macerations and decoctions of corpus luteum gravid or periodic but we have used the gravid most because the majority of cows killed in the slaughter house were

pregnant It is impossible for us to say that there is any special difference in the action of the extracts

Immediately following the injection of doses of 20 cubic centimeters of maceration or decoction of gravid corpus luteum at 14 or 15 there is a marked very rapid hypotension of 50 60 70 or even 80 millimeters of mercury The pressure falls rather rapidly cardiac pulsations are generally considerably weakened and there are sometimes in the first moments deep convulsive respirations After 1 or 3 minutes the pulsations strengthen and the pressure rises This is relatively rapid at first After 5 7 or 10



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 y d coct t th m b

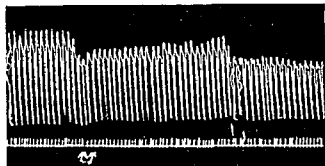


Fig 16 Frog's heart *in situ* Suspended Venous injection (between arrows) of 10 drops of gravid corpus luteum decoction at 12

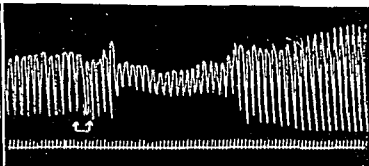


Fig 17 90 gr heart *in situ* suspended Venous injection (between arrows) of 10 drops of gravid ovary decoction at 12

minutes sometimes more the pressure returns to normal at other times it persists a little diminished (Fig 5 6 and 7)

Respiration is momentarily accelerated after injection but then becomes normal however at times there is diminution of the amplitude and some pauses

From maceration or decoction of the ovary a hypotension is obtained which in general is less than that obtained from equal doses of gravid corpus luteum often it reaches a equally low level but it is the rule that the hypotension is less durable and cardiac weakness is much less pronounced Analogous modification in the respiration is observed (Figs 8 9 and 10)

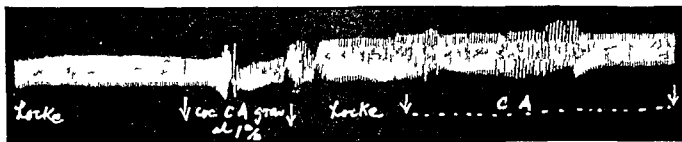
Fluid of ovarian cysts cause no reaction Decoctions of corpus luteum and of the ovary are more active than macerations

Second and third re injections of ovarian extracts are usually active but at times the effect obtained is less and may be absent With gravid corpus luteum extracts re injections are generally active although they cause less fall in arterial pressure however they may show little efficacy or no effect in large doses (Fig 11)

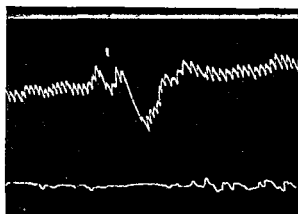
This as we know has been described by Chumpey and Gley under the heading of tachyphylaxia

Adrenalin and hypophyseal extracts produce their effects during the hypotension produced by the extracts of gravid corpus luteum

Neither previous vagotomy nor atropinization prevent the hypotensive action of ovarian and corpus luteum extracts (Fig 1 13 and 14)



Figs 8 (above) and 10. Graphs of perfusion of isolated heart of rabbit with Locke solution and 10 drops of corpus luteum of pregnant cow



Fg St m h t n l i t k ft
j to f b t m t f d oct f g d
q l t m pe t Cl l d d g ght o
kl g m

In the atropinized animals before making the injection of the extracts we have found that the strongest excitations with the faradic current caused no action on the heart. This appears to indicate that the hypotensive action of the extracts is due to a vasodilatation.

Action upon the vessel. Hallion found that vasodilator action in the nasal fossæ and in the kidney was small but that there was a selective influence on the thyroid circulation which produced an intense vasodilatation and increase in the size of the organ. The action of the thyroid seems favorable to a thyroid ovarian synergia and it has been invoked to explain the menstrual congestion of the thyroid by ovarian hypersecretion a supposition which is not proved however. In guinea pigs after injection of these extracts we have found a marked hyperæmia of the intestine of the uterus and its annexæ and also in the breast in bitches cats and humans. In the uterus of the rabbit this appears clearly in the farthest arterial

G l Ph l cl l d h p i f h f
ns f b r l hes B Au t d t A M d
l ns L ni r h h H po l K d t A M d
A t s j



I g I o l t d te f g bbt th d oct n
f p l t m f g a d s p c t

branches exactly as is met in an injected organ. Instillation of gravid ovarian and corpus luteum extracts does not produce hyperæmia of the conjunctiva as some authors have asserted.

Action upon the heart. We have already said that solutions of gravid ovary and corpus luteum generally produce at first a diminution in the amplitude of the pulsations which is generally accompanied by tachycardia. This action is also produced after double vagotomy and atropinization. We have studied the effects of these solutions upon the heart of the frog (*Leptodactylus ocellatus* [v] Gir) *in situ* inscribing the cardiac pulsations by means of the Marcy cardiograph or by the suspension method. In order to obtain modifications it is necessary to inject strong doses in the abdominal vein (5 to 10 drops of decoction at 12). The intra-peritoneal or subcutaneous route did not give the least effect in prolonged experiments. After injection there is observed a very pronounced diminution of the systolic energy, the ventricle also remains ruddy, not emptying energetically nor becoming pale with each systole as is customary. Ventricular contraction is slow and some ventricular pulsations often fail. This is the cause of arrhythmia as with the auricles pulsating energetically in their normal rhythm there seems to be an incomplete auriculoventricular dissociation, a partial heart block in which an auricular contraction without recovery is followed by another with ventricular recovery. All the effect disappears in a minute or less.



I g lte s of bbt f I ject t th l f b t m t f c rp l t m f e n a t
pc c t

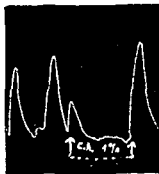


Fig 3

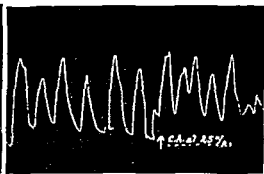


Fig 4

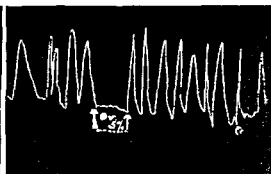


Fig 2

Figs 23 24 and 25 Action of corpus luteum of pregnant cow upon esophagus of toad Observe the inhibition

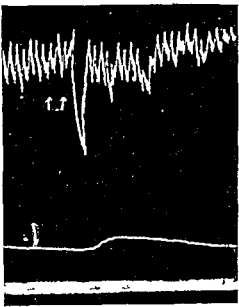
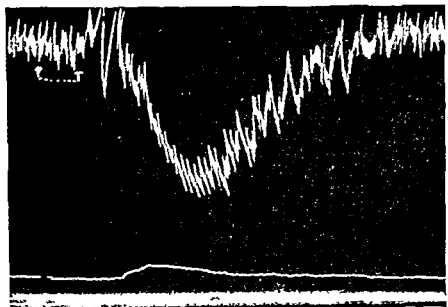
after the injection. A second injection with gravid corpus luteum has no effect but with ovary the effect is generally reproduced. As the number of experiments is small they can not be very conclusive (Fig 15).

By the suspension method there is a perfect appreciation of the relation between the ventricular tonus and the amplitude of its contraction (Figs 16 and 17).

We have studied the action of ovary and corpus luteum solutions on the isolated heart of the rabbit kept alive by perfusion in Ringer Locke serum at 38 C employing Pachon's arrangement. By this method the pulsations of the heart can be maintained without apparent alteration for over 3 hours. With the heart functioning thus ovary

and corpus luteum decoctions of different kinds are introduced in the oxygenated Ringer Locke fluid. With a strong decoction 1:100 of gravid corpus luteum after some ample pulsations cardiac irregularities are observed. Bradycardia and diminution of the amplitude of the pulsations occur and then ample and frequent pulsations as in the beginning are resumed.

It is constantly noted that on lavage with the Ringer Locke solution the pulsations are more ample than at the beginning of the experiment. If after one perfusion without ceasing to irrigate the heart with the Ringer Locke solution a second perfusion of corpus luteum at 1 per cent is made there is very little reaction but nevertheless the amplitude



Figs 26 (left) and 27 (right) Chl ralzd d d g eight 4 k l g ms C rotid p es u e l a t p l thysmo e m follow n injection (b t rro) of 10 c l nt meters of d-coct n f g a id r p s l ut m of c 5 per cent (p e r v e d 4 l u r s n e f r g r t o r)

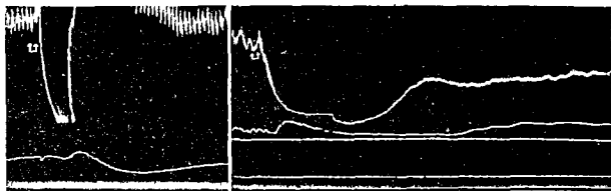


Fig 8 (at left) Chloralhydrat 4 kal g m
C t d p e s s u r b s t p l t h y m g m V j
t i o n (b e t e o w) f o b c e n t m t f g d
o n d t u o s p e t

Fig 9 Chloralhydrat 5 kalog m A t r i a l p s
b t p l e t h y s m g m I j e c t i o n f s b c t
m t f d c o c t f g d o r y s p c t

of the auricular and ventricular systoles is increased (Figs 18 and 19)

With decoctions of ovary at 5 per cent we have obtained a similar effect to that obtained with pregnant corpus luteum at 1 per cent

On the smooth muscular organs Intestine
In rabbits toxic or subtoxic doses produce peristaltic contractions perceptible beneath the skin. A very strong intoxication and an asphyxiating effect on the respiration is often observed.

In the dogs in which we have studied the action of the extracts upon the arterial pressure we have always seen evacuations produced after the injections at times repeated i.e. diarrhœa borborygmus is frequently heard.

In our studies of the action of decoctions of corpus luteum and of ovary upon the isolated intestine of guinea pigs we have constantly seen that even with considerable dilution there is a very evident marked strengthening of the muscle tone and of the rhythmic contractions. There appears to be a series of rings in the intestine which give an moniliform aspect to the organ shortening the intestine segment and momentarily evacuating its contents. Unfortunately through a deficiency in our apparatus we have not been able to obtain good tracings but we shall repeat these experiments.

Stomach These experiments were on dogs. The stomach was filled with water the cardia and the pylorus tied over a cannula which

communicated with the stomachal cavity and with the lateral tube of a flask half filled with water. The upper orifice of the flask was closed by a stopper traversed by a glass tube and connecting with a Marcy inscribing drum. Following injection there is observed an inhibition of the rhythmic contractions of short duration then the contractions become strengthened by degrees until they attain an amplitude greater than that at the beginning of the experiment (Fig 20). The same effect is observed in making re-injection with stronger doses.

Bladder We have frequently observed micturition after the injection of corpus luteum and ovarian extracts but we have not been able to make tracings. We have observed contraction in the guinea pig.

Uterus We have noted that the uterus of guinea pigs shows a marked hyperæmia. In the isolated uterus of the guinea pig kept in the Ringer Locke fluid at 38° we have observed that ovarian and pregnant corpus luteum extracts produce a tonic contraction with increase of the rhythmic contractions although a sensitive apparatus does not register graphs (Figs 21 and 22).

Esophagus of toad The isolated œsophagus of the toad is suitable for the study of effects of different chemical or physical substances on the function of smooth muscles. The extracted œsophagus preserves its rhythmic contractions for some time even for some hours at laboratory temperature if the precaution is taken to keep it warm and

experiment inasmuch as we can place glass cannulas in the galactophorous canals and by means of the Desprez apparatus obtain a tracing of the issue of the drop of milk through the cannulas. At the same time we take plethysmograms of the breast the arterial pressure is taken from the carotid.

The dog is not very suitable since cutting of the nipple causes coagulation of the blood of the wound. However by the insertion of the cannula we obtained good tracings. It is seen from them that conjointly with the fall of the pressure (the action of gravid corpus luteum is more active than ovary the action of this being slight) there is dilatation or turgescence of the breast not alone in the graph but also macroscopically and drop of milk issue by the cannula (Figs 6 7 8 and 29).

I think that it will be possible to make use of this galactagogue action. I think the buccal way is the easiest and after many trials I think that the best daily dose is 0.05 centigrams (0.10 the first and 0.05 on subsequent days) of powder of corpus luteum of young heifers.

It is noted that the action is very efficacious in puerperal hypogalactia. In this condition with 0.20 or 0.30 centigram we have many times found nursing regularized (ad ministering 0.05 centigrams every day). At times it is necessary to continue 1, to 20 days suspending for 3 or 4 and then again resuming. Up to now I have observed no contra-indication except menstruation. When this appears it is better to cease in order not to

increase the accompanying subjective symptoms.

Drs. Berutti and Comi Bazzan used Ovarine at first but have recently informed me that with corpus luteum powder there is a more intense action.

As is seen the substance or substances which the ovarian or corpus luteum extracts contain the chemical nature of which is unknown to us have an action on the entire economy but in my opinion it is exercised on certain parts of the sympathetic system.

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H y f l d t d o p t a th k

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A ult l v t f lt i B A

ACUTE DIVERTICULITIS OF THE COLON

ITS CONSIDERATION¹

By JOHN F. FRDMANN, M.D., F.A.C.S., NEW YORK.
 P. I. (S. g. r. y. N. Y. A. P. t. Grad. t. Med. 1881) d. H. pt. 1

IN two previous communications upon this subject I have reported 16 cases coming under my observation of acute diverticulitis of the colon. Three of this series were not operated upon by me but gave such characteristic symptoms of the disease that I do not hesitate to report them as true cases of acute diverticulitis.

Since May 18, 1914, almost three years I have seen and operated upon 10 more patients while Dr. Thomas H. Russell, who was my assistant at that time, saw during my absence from the city and operated upon one patient during the summer of 1916.

One of the patients was reported as Case 7 in my original article in the *Iale Medical Journal* February 12, as having been operated upon in 1903 or 1904 for a supposed left-sided appendix but which I (in the afore said article) felt satisfied then was a diverticulitis.

This patient was seen by me in 1915 again for an acute left-sided mass and the statement made by him was that about once every ten or twelve months he would have an attack of pain, vomiting, etc., followed by a mass formation in the left side that in a day or two an opening would appear discharging foul brown-colored pus. The opening would discharge for a week or so and then close with perfect health until another attack.

I saw him again June 23, 1916, with a very grave attack. This time his family physician, Dr. Leiser, and myself were finally able to secure his consent to be operated upon. There was a temperature of 103, pulse 100 to 110, and a large, tender, quite painful mass the size of a fist in the left loin. A discharging sinus was not in evidence at this time.

On opening the peritoneal cavity there was a free discharge of foul pus and a fairly easily displaced giant-like sigmoid with one gangrenous perforated epiploon on its left side and one fistulous tract on its right superior border attached to the parietal peritoneum. This was the canal of the original diverticulitis 13 years before.

The patient's condition illustrates the fact that as long as a diverticulum exists

there is the possibility of an acute attack and as the attacks never come singly one can see the futility of promising future freedom from repeated outbursts. Nevertheless the rarity of a second gangrenous and abscess attack makes possible a very wide percentage of non-occurrence.

The sigmoid found at the time of operation was so thoroughly infiltrated and with numerous epiploon invasions that an immediate repair was not considered justifiable. That part of the sigmoid involved was placed extraperitoneally and walled off with gauze, being supported in addition by a rod as in the preliminary step of doing a sigmoidostomy. A few days later a resection was made of this part of the gut and an end-to-end anastomosis done. Recovery was obtained after some weeks of fistulous discharge.

Even beyond the sigmoid non-involved diverticula were observed. The portions removed contained numerous non-invaded diverticula, some containing fecoliths, while one was perforated and gangrenous and another the 13-year one presented a perfectly healthy channel communicating with the gut.

Sex. Of the 27 patients, 5 only were females or about 5 males to one female. Carnian states that there are 2 to 3 males to every female. Of the 7, 1 was of the ascending colon, the remainder in the sigmoid.

Carcinomatous in element. In one female and one male carcinoma was diagnosed as having been found implanted upon or coincident with this condition. One of the patients operated on had been reported once by me as a carcinoma. This patient was without question one of the cases of so-called cures of carcinoma that are later proved benign. She was operated upon by me for malignant (?) obstruction of such an involved area as to preclude excision. An artificial anus was made. Sometime after ward faces began to move *per anum*, the patient gained weight, never having lost and was kept under observation by me for years. Finally the artificial anus ruptured.

and the pelvic mass was found to have disappeared. As a possible source of carcinoma diverticula cannot be denied any more than can the possibility that a gastric ulcer will become a gastric carcinoma.

Symptomatology. The patients are usually well preserved in fact not one of the 27 could be called slender.

In several complaints were made of an occasional sense of soreness or distress in the left lower quadrant and hypogastrium. There were present no mucus nor blood in the stools; there was a tendency to constipation, occasional dysuria and frequency, occasional mild acute attacks simulating very much the mild to profound attacks in the right lower quadrant when one has the appendix as the source of complaint. One of the last series in fact was operated upon for an appendicitis, all his pain being on the right side. Upon opening the abdomen over the cecum a gangrenous diverticulum about 1 1/2 inches long was seen upon the colon near the terminal portion of the cecum (Fig. 1) while the appendix perfectly normal lay downward and inward.

There is an absence in the history at least of pus, mucus and blood in the stools and upon examining the patients with a proctoscope it is rare that a lesion can be discovered; it is possible with good inflation of the sigmoid and a proper illumination one might in certain instances see the wider mouthed diverticula—especially so if a concretion lays near or in the mouth.

These symptoms are so characteristic that one can advance rather safely the diagnosis of suspected diverticulitis and if not acute refer these patients to the X-ray diagnosis. These pouches are at present being found quite frequently in the X-ray search.

The youngest patient of my series was 6 years old and the oldest 81; both male; the majority were between 40 and 48 years.

There were three deaths in 25 patients operated upon: one from sepsis in a case of gangrenous perforation with retroperitoneal abscess formation, drainage only being done; one resection in a subsiding acute case with retroperitoneal lymphatic absorption, sepsis; one acute intestinal obstruction following a

resection of 10 inches of sigmoid for multiple perforations, two in the bladder, two in adherent loop of the sigmoid and two in an adherent loop of the ileum. This patient had a second operation for acute obstruction due to a loop of jejunum becoming adherent to the anastomosis and angulating.

Fistula postoperative. The operation for immediate repair of the perforated gangrenous diverticulum is very apt to be followed by a fistula. There were 4 such postoperative results in this series: one mentioned before in which the fistula continued for quite a number of months then closed and reopened for ten or twelve years; about every 10 months; one that although union was positive opened in the seventh week and continued to discharge almost constantly for 17 months; now has been closed for 6 months; one physician weighing 240 pounds at the time of his first and second operations (Case 1 in my series also reported by Dr. William Mayo) had a fistula or sinus for several years but is well now 4 or 5 years. The fourth was a woman in whom I had some difficulty in placing my suture. The wound leaked for about 3 months but is now cured for about 18 months.

These sinuses discharge a fluid which varies in consistency from a thin slightly colored non-odoriferous fluid to a distinctly fecal mixture with an occasional evidence of gas with now and then a small fecal mass.

Differential diagnosis. rests between a possible but rare left-sided appendix and carcinoma. That a left-sided appendix may be present has been demonstrated or at least it is evident and has been proved numbers of times that a normal ileocecal origin appendix may be so long as to extend to the opposite side. Abscesses have been opened in the left that subsequent operations proved to be of appendicular origin in the right side.

Carcinoma. Here we have especially in the adenocarcinoma a disease of late years while diverticulitis usually occurs in the earlier years. Ulcerative perforation in carcinoma without previous distinct symptoms for some time are exceedingly rare. Carcinomata usually give rise to mucus and blood, singly or combined in the stool, diar-

rhœa and constipation alternating loss in weight secondary anemia prostration cachexia etc

By proctoscopic examination usually evidences of mucous membrane invasion if the tumor is within 1 to 1½ inches of the anus are found

Terminations of diverticula These may be subacute in their manifestations or acute as seen in appendicitis or chronic as thickening with obstructive symptoms and finally as carcinoma implantations

The subacute conditions have been considered as those of a growling appendix and in all probability are due to overdistention of the pouch with fecal matter or irritation by some sharp substance as for instance in one patient seen by me in whom a shell of a rice kernel was lodged in the pouch. Such masses produce irritation possibly in the efforts of the bowel at ejection

Acute manifestations The acute manifestations include all the phases seen in a diseased appendix so called catarrhal subsiding abscess formation—the abscess either being in protecting folds of intestine and omentum or if the diverticulum be in the tissue between the peritoneal folds a retroperitoneal one gangrene with or without perforation etc. In many of these perforation of the abscess into the bladder or into the adjacent gut has been demonstrated. Two such patients were seen in this series one reported in an earlier communication and the multiple perforation referred to in this paper

Chronic type is due evidently to a recurring condition or chronic irritation. Here we may encounter the condition described by Wilson of a peridiverticulitis consisting of chronic proliferation extramucosal inflammation with round cell infiltration which results in mass formations and may encroach upon the caliber of the gut to such a degree as to become obstructive and be taken for malignancy

Carcinomatous involvement has been considered above

Gross pathology Upon opening the abdomen the picture varies as to the intensity of the process. Noninflamed diverticula

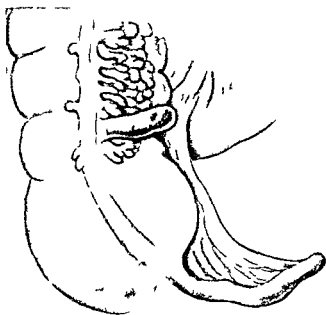


Fig. 1. Gangrenous perforated diverticulitis of the ascending colon

are seen protruding from all or rather any surface of the gut bleb like but resistant to the sense of touch presenting evidences or not of foreign body contents. The acutely inflamed varies from a markedly injected diverticulum to a gangrenous perforated one

In most of my patients with acute lesions the condition was found to involve one or more of the epiploons. These tabs of fat were either very hard and intensely injected or hemorrhagic to gangrenous

On section of the epiploon near or at its base one rarely fails to demonstrate the presence of the diverticulum. These bodies or pouches are round or ovoid and from a pea to an egg in size and contain mouths or openings into the gut from probe to full pouch lumen. The gross appearance of the resected or opened colon is that of a healthy mucous membrane thrown into folds with here and there a cleft or long opening into which an ordinary probe to an instrument of considerable size can be passed. Here and there foreign bodies or fecal concretions are readily seen occupying the diverticula. The wall of the sigmoid or colon in the chronic case is thickened while the caliber is distinctly diminished

McGrath¹ has shown that most of the

diverticula are of the false variety and that the mucosa is pushed through the muscularis where the vessels penetrate the latter.

Causation Much has been said concerning the origin or causation of these protrusions.

Hartwell and Cecil sum up their opinion as to the etiology of the disease after considering the various theories and arguments as follows:

We therefore are driven to the conclusion that up to the present time no complete explanation of the primary cause of intestinal diverticula has been offered. The most that can be said is that for some cause a weakness exists in the intestinal coats and by reason of the weakness pouching of the coat takes place beneath the perisperm.

Diverticula formation was attributed by Graeser to hernial protrusions which follow the emerging veins after taking a wandering course through the intestinal walls finally reaching the subserosa. His conclusions were based upon the knowledge gained from a study of 8 cases from which he made more than one thousand sections.

Sudski contended that Graeser was at fault that his findings were purely accidental.

Klebs noted that the diverticula occur in close relationship to the point of entry and exit of the vessels in the gut but along the me enteric attachments offering as his chief among numerous arguments that the intestinal wall is weakest at the me enteric attachment.

My personal observations in the acute as well as in chronic cases has been that the diverticula may occur at any portion of the circumference of the gut and in my acute cases most frequently in the anterior and lateral margins especially so in the region of the fat lobules or omentum.

Traction upon the me enteric border was given by Klebs as a productive cause through possible weakening of the wall resulting from the traction.

Old age as a cause is disproved by Ashurst's case a boy of seven, two cases of Hartwell and Cecil of seven and ten years and one of my own at six years and the great proportion of the cases under consideration in this communication under 45.

Inferences to the literature and our personal experience produce sufficient evidence of the fact that the entire alimentary tract from the œsophagus to the rectum is subject to the outputs.

Recently I operated upon a female patient in whom a diverticulum the size of a large prune of the second and third portions of the duodenum was removed. I have also removed several appendices in which single to multiple diverticula could be demonstrated.

These protrusions are classified as acquired or congenital and false or true the false in which one or two coats are absent the true in which all coats are present. The false and true classification is the more popular for working here.

The number of adverbs in which diverticula are found upon autopsy that are merely curiosities or entities and not pathological cause of the disease prove that diverticula like gall stone etc. are harmless until certain change arise producing the necessary irritation or inflammation to become an irritative symptomatic or destructive. The change may be allied to the cause arising in the appendix from a simple congestion mildly acute to gravely acute exudative and obstructive by adhesions or thickening ulcerative in finally carcinomatous.

Acute diverticulitis either in the œsophagus small intestine or colon is due to food retention with irritation in the œsophagus and intestinal varieties while in the cecum and appendicular varieties it is due to feces or foreign bodies is the hook of oatmeal or rice bodies.

Operative treatment In the acute types one either drains or excises and sutures in appendicitis. In a great many of the acute and gangrenous cases one can excise the protrusion relieve the edema if necessary and suture while in other patient the œdematous condition found is obstructive to suture work and one must rely upon draining or upon imperfect closure of the opening by sewing surrounding omentum to the intestinal opening. Where the opening exists in the me cecocolic or meocolon plicum one or both layers of the peritonium forming the meso structure and draining is advisable.

In the chronic infiltrated obstructive type excision of the gut is demanded with anastomosis preferably end to end. In the irritative variety non-inflammatory or acute careful attention to the intestinal tract and warning the patient of the acute emergency possibility is in order.

Attention has been called to the possibility of succeeding attacks occurring. These are not of necessity in one diverticulum but as

in the case referred to in several different diverticula. Such an occurrence as before stated will of necessity provoke a very guarded prognosis as to cure and should also cause us to give a very guarded prognosis even after successful resection of certain segments as the presence of diverticula throughout the colon is more than possible although not visible during the operative procedure.

THE RECOGNITION AND TREATMENT OF INTESTINAL DIVERTICULA¹

By DUDLEY ROBERTS M.D. BROOKLYN

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EXPERIENCE of recent years has shown that diverticula of the intestinal tract are frequently to be found if properly searched for. We have in fact reached the conclusion that every pocket-bellied individual over sixty should be under strong suspicion of having multiple diverticula of the colon particularly if there is a history of long standing constipation and lower abdominal discomfort. Surgeons have learned that acute diverticulitis and peridiverticulitis are by no means rare. As radiography now makes possible the recognition of the presence of these diverticula with absolute certainty the clinician should be on the alert to establish the diagnosis, be prepared to correct the local disability by proper measures or offer operative relief without delay for the lesions that are found to have resulted in partial obstruction, involvement of the peritoneum or cancerous degeneration.

RADIOGRAPHIC METHODS

In 1914 Carman (1) stated that after examination of specimens in the Mayo Clinic he was convinced that the radiographic demonstration of diverticula was impossible. Subsequently three cases presented themselves in which this was contradicted. It is true that in many cases it is very easy to overlook diverticula in making roentgenographic studies of the gastrointestinal tract.

It is also true that in early cases before there is much retention in the pockets or when the diverticula are few and lie directly in front or behind the lumen of the bowel diagnosis may be uncertain or incorrect.

Dependence should be placed on daily studies of the colon from twenty-four hours after the opaque meal is taken until it is entirely discharged from the bowel. Stereoscopic plates are of the utmost value. As many of the patients are exceedingly corpulent overlapping even the largest available plates it is wise to take small plates of the descending colon, sigmoid and rectum with the idea of securing the greatest possible detail. For this purpose it is necessary to have satisfactory intensifying screens, a long narrow cone and a tube giving good detail. The results of plates taken after opaque enemas are often unsatisfactory as the diverticula are covered by the distended lumen. They may be invaluable however if taken when diverticula are filled with bismuth taken by mouth and the enema is less opaque. Valuable information is often secured from plates taken after the expulsion of the enema. Attention should be called to the importance in diagnosis of a peculiar jagged appearance of the sigmoid when seen filled with opaque enema. This sawtooth sigmoid is so highly suggestive of diverticula that its presence should lead to the employment of

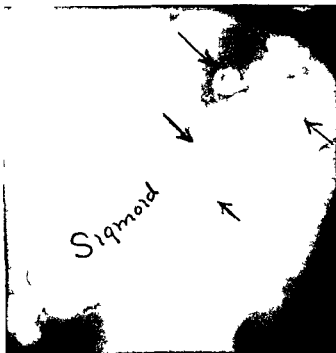


Fig 2 Case 9 48 hours after opaque meal Some spots remain filled after lumen of sigmoid is emptied

examination shows general catarrhal inflammation no sign of diverticula Radiographic examination shows multiple diverticula along entire colon No suggestion of pericolicitis (Fig 1) Almost absolute freedom from complaints under treatment

CASE 10 Male age 39 Sour stomach for years For few years constant gas in lower abdomen never severe discomfort Bowels always costive Sigmoidoscopic negative Patient very large abdomen protuberant No mass no tenderness Radiographic examination saw tooth sigmoid on enema plates residue in diverticula of sigmoid from opaque meal Almost entire freedom from symptoms under treatment Constipation not entirely corrected

CASE 11 Male age 1 Lower abdominal pain for several years worse in recumbent posture Bowels obstinately constipated At one time a mass was said to be found in left iliac fossa Patient very large abdomen protuberant Sigmoidoscopic examination negative Radiographic examination saw tooth sigmoid by enema plate Opaque meal how residue in multiple diverticula No definite improvement from treatment has persisted in use of drastic purgatives

CASE 12 Female age 68 Seven year complaint of distress in lower abdomen and left hypochondrium Always costive worse for two years Very large fat protuberant abdomen Radiographic examination marked saw tooth sigmoid on enema plate opaque meal showing multiple diverticula of entire colon Patient reports almost entire freedom from complaints in past year

CASE 13 Male age 60 For six months lower abdominal distress rectal tenesmus passage of



Fig 3 Case 14 Hist No 15/0 Opaque enema shows saw tooth sigmoid Opaque meal study demonstrated diverticula

mucus no blood Patient large fat protuberant abdomen Sigmoidoscopic examination shows subacute catarrh no bleeding no other lesion Radiographic examination multiple diverticula of sigmoid apparently a peridiverticulitis of lower sigmoid Freedom from complaints under treatment for past five months

CASE 14 Male age 35 Lower abdominal distress for five years both right and left sided Bowel costive for years Patient large fat protuberant abdomen Sigmoidoscopic negative Radiographic examination saw tooth sigmoid by enema plate opaque meal shows multiple diverticula without long retention in pockets (Fig 3) Lower abdominal distress practically relieved under treatment

CASE 15 Female age 36 Lower abdominal discomfort for five years three attacks of severe pain in lower left side said to have been accompanied with marked tenderness and rigidity Picture indicated localized peritonitis tenderness rigidity mass (Fig 4 and 5) temperature nausea and vomiting Operation advised Abscess found in left iliac fossa multiple diverticula of sigmoid with one perforation Drainage and uneventful recovery

CASE 16 Male age 35 Twenty years previous had attacks of abdominal pain without fever tenderness or rigidity Frequent from pain for some years Always obstinately costive Lower left sided gas pains for three months Bowel more obstinate no blood or mucus observed Patient fairly large protuberant abdomen Sigmoidoscopic

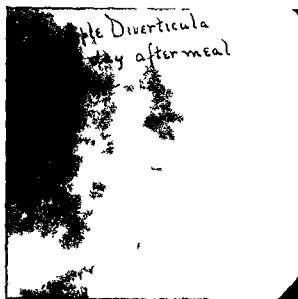


Fig 4 C s s l d t l t d
ft h t \ t mpt d by th

eminant on l o l o l y i t r h a l i n f l a m m a t i o n
s h i g h a s c o u l d b e n R a d i g r a p h i c e m u
t o n m u l t i p l e d i v r t i c l f s i g m o i d n i d l i n g
c o l o n i t h n r n g f l m n f s i n c h s
P o c k e t s i n f i b u s u t l f r t k l r o m p t
r e l f o f c o m p l a n t b o l s e f f a c t u a l l y r g u l a t d b y
d e t a g a r a l n n e l o u s

CASE 17 Male age 49 7 n year l r
a b d o m i n a l d i s t s b o l m o t i t e n t
m o d e r t e i z e t h s m h a t r o t u h n t b l m e
S i g m o i d o s o p i c e n t o n g a t i v R l i g r a
p h u a m t i n n t l e c n d g l l s
p u c h s o n n e r l n u t h p l t h i d
A p p a r e n t l y a l y p o u h i g f c l n p l l y
f e v m o a d i c d S y m p t p r p t i v r l i e d
u n d e r t r e n t n t

CASE 15 Male age 17 t a s l r
a b d o m i n a l d i s t s f l y n e r h m o i g r e l e d
b y d e f a t i a N r l f f r o n a p p i d t m y n e
y a r a g C t p a t d f r y e r s l a t e n t l t e
s i z e a b d m n n o t i t c u l a l y p t u b r a n t R a d o
g r a p h i c a m u t i n p u c h e a l n g n t r e
o f d e s c n d i n g c l o d n t a c t u a l l y t a n b m t l
i l n l m i e m p t i c E m a p l a t s h a
t o t h i g n o d A l l r t l y n a l y c s o f
a c q u i r e d d i e r t c u l t i U n i r t a t i f r o l y
s h o r t p r o l o m p t l f

CASE 9 Male age 10 r v r i g a t r
h u n g e r p a n p a i n i n r i g h t a d l f t l l a f s
O b s t i n t l y c t e k a t l r a l l i l a b d m
f l a t S i g m o d o j n g a t i v R l i g r a p h i c e
a m a n a t i o n d u o d e n l u l r j p n l t c a c a l
a n d h n k e d a t i d c a l t h e d g l a n d i m e n t r y
m a r k e d r e c t a l o n s t p a t o n t h d r t c u l a p o u c h
i n g n o t h o l l i n g b y m u t h f t r l u n e p t e d
O p e r a t i o n e n f m e d f i n d i n g s n p r i d v e r t u l t s

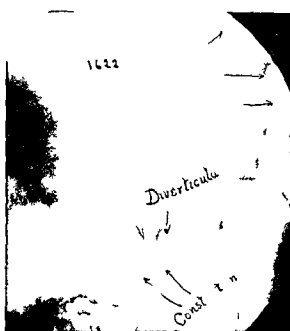


Fig 5 C m l y m t h d f t p l t t k d
C t t d l m h m b d a m d

CASE 20 Male age 17 t v e l e
a b d m u l d o m f o t a n d n r e i t p a t o n
F r m n t h t a b l i t y o f b l d e r f r j a s t k g a
a p p a n t l y p a l t h u g h u t h r a l t n t m o d
a t l i l m p t u l e n t s n a t i m s
n l f t l l a t s s i g m o d c p d t r e a c h
a l l i f a n y k n l t n e h p a n d
c l b a l l l a d i g r a p h i c a m n t i m l t p l e
l e t i l a l n g n t l e l i g l o p p r e n t
o b t i n t n t m n l e i g m l O p e r a t o
r e f u s e l l t l n k f r y a l i t e c t n

CASE 21 Male age 3 M a y s c s t v s
f r p t l s m t h s h d c l d i j n e
t j a l p t t n F r t h e m n t l l r
a b d m l l m f r t i l t l i e b l u t i g L o t
f l e l n l t g l S i g n l o p c c a m a t i n
l n l y b l o d n u v c m i g f o m b o
L a t e r c a m a n a t i n i t e l i g p h l g o i
h l m a l g n t g v t h s i g m o i d t n h
f r n a n u s l d i g g h e a m i n t i n m l t p l e
d i t u c l a o f l n c a c e f l t e t n l
l t r t o l a g e p o p t n f b i s m t h a l n
g l t i a l f e l n o c c k a t r n t p t
f i l a t e o g l l n e m a t (Fg 6) O p r a
t n a l y s e d

CASE 16 Male age 3 C t p a t d i y e a r s
F r o i y e r p a l e a b l n e n a l y i g h t
l l f o a l o t m n t h s l a p a s l b l d b y
r e c t m V e r y l e g e b d m i p r t u b t C a n
c e r e f o u r i c l e r b a n u s b y s g m o l p y
R a d o g r a p h i c m i n a t i n m l t p l e d i v r t i l a
o f s g m o d D o b t f l d n f a n c u m s

Operation demonstrated cancerous growth in upper rectum. Multiple diverticula of sigmoid readily seen as lumps protruding from the surface of the bowel. They are almost entirely at the base of an epiploon. The concretions in some felt almost like stone. Some of these concretions could be delivered by pressure into the lumen. One which was removed had an opening into the lumen which could hardly be seen.

CASE 3. Female age 46. For five years indigestion, sour stomach, gas, belching. Always constipated. For past year more or less discomfort in left iliac fossa. Patient very fat, abdomen protuberant. Sigmoidoscopic examination negative. Radiographic examination, one large diverticula of descending colon. Several small ones seen in sigmoid.

CASE 24. Male age Constipated for years. For past two years sudden sharp pain in left hypochondrium and down left side. Very large fat protuberant abdomen. Radiographic examination shows multiple diverticulum of sigmoid by opaque meal and bismuth enemata.

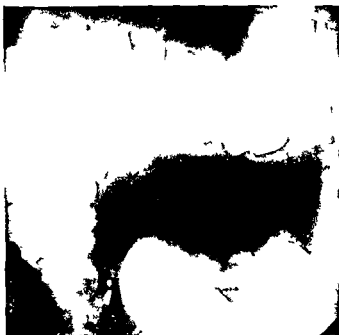


FIG. 6. Case 1. Right half of colon to splenic flexure. Residue of bismuth meal given one week before. Plate after expulsion of enema shows diverticula. Cancer gave deformity on series of plates.

ANALYSIS OF TWENTY-FOUR CASES

Sex	Cases
Male	18
Female	6
Age	
8th decade	8
7th decade	5
6th decade	4
4th and 5th decades	5
Clinical complaints	
Protuberant abdominal distension	14
Intermittent diarrhea	5
Cholicky attacks	3
Nausea and symptoms (both in 1)	
Rectal tenesmus (one cancer)	
Fasciculation of blood (1th cancer)	2
Constipation long standing	10
Alternating constipation	
Diarrhea	

APPARENT PATHOLOGICAL DIVISION

Sigmoiditis (practically all)	
Familial diverticula (young subjects)	
Early polyps (age 4 to 5)	3
Numerous small diverticula	
Marked diverticulitis	3
Acute diverticulitis (with rupture)	
Cancer	

ETIOLOGY

The etiology of diverticula was reviewed in 1913 by Beer (1) and since that in studies by Wilson (2), McCall (3), Giffen (4), Hirtwell and Cecil (5).

PROGNOSIS

Apparently a few or single protrusions may occur in early life. Idmann's statistics on acute diverticulitis would indicate that acute

perforation occurs at an average age lower than in my series. Possibly it may be deduced from this that diverticulosis while a common affection is attended as a rule with a protective inflammatory reaction. The frequency with which we are finding diverticula in elderly fat habitually constipated individuals and the infrequency with which acute peritonitis has occurred in this class in my experience leads me to the opinion that the prognosis is favorable and that accidents are unlikely. The danger of benign stenosis would also seem remote although partial obstruction is probably not rarely developed. The occurrence of multiple diverticula in two of the last three cases of the rectum and sigmoid which we have studied suggests that it may well be an etiological factor of importance. How frequently this obtains must be decided by radiography of a long series of cancer cases. Whether on the other hand it is ever wise to resect a portion of the colon affected with diverticula because of the danger of cancer is doubtful.

TREATMENT

Medical treatment of diverticula has proved to be exceedingly satisfactory. While it is

true the diverticula will remain in spite of what is done there can be no question but what symptoms are almost entirely relieved and probably the progress be stayed so that obstruction peridiverticulitis and acute diverticulitis be made less likely.

1 *Avoidance of laxatives* Practically these patients do better without laxatives which cause fluid stools. Whether this is due to the avoidance of abnormal pressure in the colon, avoidance of spasm of an irritated segment of the colon or the absence of fluid feces to fill the pockets we do not know. In spite of the long standing constipation it is usually found that the bowel will move satisfactorily on a vegetable diet plus daily doses of agar and the mineral oils or the more solid petrolatum jelly. If necessary small injections of warm oil may be used immediately preceding the time for defecation.

2 *Large doses of bismuth* Experience has demonstrated that weekly or biweekly doses of barium or bismuth one ounce in emulsion or buttermilk is exceedingly useful in fact that it is an almost immediate panacea for the clinical complaints. Strangely enough in such doses it is seldom constipating sometime being actually laxative. Some thing must fill these pockets and a non toxic unabsorbable bland substance would seem to be preferable to putrefactive feces. Certainly the results are striking. An enema may be used if it is found that the pockets are better filled by this method. Constant repetition is the important thing for even with laxatives and enemata it is sometimes difficult to actually empty the pockets at one time.

3 *Injections of hot gelatin* In cases with sigmoidoscopic evidence of ulcerate catarrhal inflammation injections of eight ounces of a 10 per cent solution of gelatin introduced into the sigmoid at a temperature of 100° F. have been found to be excellent.

4 *The use of antispasmodics* In a few cases severe spasm of a particular section or the entire colon attended with very severe pain has made necessary the use of antispasmodics. While bromide and belladonna are useful I have found that urea derivative closely akin to veronal sold under the name

of luminal has immediate and absolute effects. It is sufficient to use one third of a grain three times daily for periods of five days with an equal interval between.

INDICATIONS FOR SURGERY

Acute diverticulitis with abscess formation closely simulates the picture of acute suppurative appendicitis and should be treated promptly in the same manner. It is difficult to draw the line between such an obvious surgical condition and conditions where there is only a small leak with peridiverticulitis and mass formation without conditions necessitating drainage. Many of these patients are such poor surgical risks expectant plans of treatment may be justified when uncertainty exists as to the absolute necessity for surgical intervention. A similar state of mind may result when partial obstruction without malignancy is discovered. Colostomy above the affected area is a simple procedure and if not done at a time of acute emergency gives satisfactory results.

The development of cancer obviously gives the immediate indication for surgery either radical or colostomy at an early date. My experience indicates that if diverticula be proved and blood and pus be found in the discharge there should be a strong suspicion of cancer even though it cannot be reached from below or distinctly palpated from above. In none of my series has blood been discovered except in two proved cases of cancer. This is however not an invariable rule.

SUMMARY

1 Multiple diverticula are very common when searched for by adequate methods.

2 They occur in all ages but particularly in the aged and in the abnormally fat.

3 Constipation of long standing is usually present.

4 They give rise to lower abdominal disability in a large majority of cases some times to pain in other regions of the abdomen sometime to severe abdominal colic.

5 Leaks and rupture probably occur in a relatively small proportion of cases.

6 Non operative treatment of the diverticula gives remarkably satisfactory results.

7 Surgery is indicated for the sequelae

rupture with acute localized peritonitis
peridiverticulitis with obstruction and cancer

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ONE YEAR'S EXPERIENCE (1916) WITH GUNSHOT WOUNDS OF THE ABDOMEN AT THE MEMPHIS GENERAL HOSPITAL

WITH A REPORT OF 50 CASES

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P. f. (S. g. ry d. Cl. IS g. ry M. d. ID p. tm t. U. ty i. f. e.)

A SERIES of cases is tabulated in this article coming from a comparatively small civil hospital representing one year's experience in gunshot wounds of the abdomen is to say the least a sad commentary on our civilization. Fifty cases of penetrating gunshot wounds of the abdomen probably as many of the chest several of the head to say nothing of the large number of gunshot wounds of the extremities proclum in stentorian tones that life is cheap in Memphis and vicinity.

As a rule we are in the habit of reporting our successes. This however cannot be done in this tabulation for our death rate is high 3 deaths or 60.38/47 per cent. The youngest patient was 8 years of age the oldest 60.38 were between 0 and 40 years of age. One was shot in 10 different parts of the body and recovered. One was shot 6 times one 5 times one 4 times three 3 times and three times making 10 with multiple wounds. One was white 49 colored. Four were females 46 males. Three colored males died without operation and are not included in the mortality rate. Eleven were shot above the umbilicus. All died. Fifteen were shot below the umbilicus and 14 died and 1 recovered. Two were shot in the right hypochondrium penetrating the liver both recovered. One was shot in the left hypochondrium and recovered the spleen being penetrated. Thirteen were shot through

the back the abdomen being penetrated and 8 recovered and 5 died. These 13 patients were some of our worst cases yet they show the lowest mortality rate. Might this not be due to the fact that being shot in the back the victims did not see the shot and the shock was lessened? Two were shot in the buttocks the abdomen being penetrated 1 died and 1 recovered. Four were shot in left inguinal region 3 died and 1 recovered. Two were shot in right inguinal region both died.

Wounds of exit were present in but a few instances 8 cases in all. In 4 other cases the ball was found immediately under the skin of the opposite side of the body and was removed. Of these 12 cases there were 5 deaths and 7 recoveries or 40.6 per cent mortality. The small clean cut perforations found in this series were at variance with the tearing of structures found as a result of bullets of low velocity. In Case 11 this was shown by laceration of gall bladder transverse colon and upper jejunum and in Case 5 by a complete laceration and separation of the duodenum at the pyloric junction. Soft misshapen bullets were extracted in both these cases.

The time of death is of more than passing interest since it must be admitted that several of these unfortunates had better been allowed to die from the effects of their gunshot wounds than to have been unwisely

operated upon. If this tabulation teaches nothing more than this the lesson will have been a profitable one.

de th o u red on th tabl	
1 n a half hou f ll vng op r t i	
3 th n a f hour tual tme n t stat i	
2 wtl n 2 hour	
1 th n 3 hour	
1 th n 4 hour	
1 tl 7 h ur	
1 tl 1 hour	
1 th 1 8 l ur	
1 th n 0 hours	
5 tl n 3 h ur	
1 th n day	
1 tl n 3 d y	
2 th n 4 day	
1 th n 6 d y s	
4 tl 1 day	
1 tl n 1 d y	
1 th n 6 day	

We have all seemed to be obsessed with the idea of immediate operation in these cases. We venture to say that those dying on the table and within 6 hours following injury comprising 15 cases did not die of peritonitis. Two died of hemorrhage. We knew they were bleeding and operated for its relief. The right internal iliac artery was bleeding in one case and the kidney in the other. The former died the latter recovered. Active hemorrhagic demand immediate operative interference regardless of the patient's condition. In the instance with bleeding from the internal iliac artery gurgling of blood was actually present and noted during the preparation of the patient. The patient died on the table. On the other hand shock is a contra indication to immediate operation. The patient that will not rally from shock after 2 hours of intelligent effort to counteract it is certainly not going to withstand the added burden of additional shock from a prolonged laparotomy. Yet we have all operated under such circumstances. I say all for the reason that the results good or bad were developed by 14 different operators. It is because of this fact that I wish to emphasize the point.

Therefore the time elapsing between injury and operation is of much interest particularly if viewed from the standpoint of final results.

Four were operated upon within 1 hour after injury and all died. died within 12 hours. 1 within 7 days and 1 within 3 days. Six were operated upon within 2 hours. 2 recovered and 4 died. One died within 10 days. 1 in 7 days. 1 in 22 days and 1 in 4 hours. Three were operated upon within 4 hours. one recovered. 2 died. 1 in 4 days and 1 in 2 days. Seven were operated upon within 8 hours and 1 recovered. 6 died. one surviving. 2 days. 3 a little over 1 day and one day. Two were operated upon within 16 hours. both recovered. Five were operated upon within 4 hours and all died. 1 living for 7 days. 1 four days. 1 one hour and 1 three hours. One was operated upon 7 hours following injury and recovered. Three died without operation. In 18 the time of injury is not stated. Eight of this series recovered. 10 died. 1 seven days and another 6 days after operation. Two of this series died on the table. Let me emphasize that the total of 4 cases operated upon within an hour following injury died. that 4 out of the 6 operated upon within 2 hours died. that 3 out of 4 operated upon within 4 hours died. that 6 out of 7 operated upon within 8 hours died. that the total of 2 operated upon within 16 hours recovered. that the 5 cases operated upon within 4 hours died. that the 1 case operated upon 3 days after injury recovered and that of the 18 cases in which the time of injury is not stated 10 died and 8 recovered. 1 of these living 7 days and another 16 days. The bald fact then stares us in the face that only 4 of the 10 cases operated upon within 2 hours recovered giving a death rate of 80 per cent and further that only 4 out of 21 cases operated upon within 5 hours after injury recovered giving a mortality of 80 per cent. Fifty two hours was the average of life following operation for these cases. 4 of which however survived only 10 for an average period of 6 hours. What we are pleased to term secondary shock was responsible for several of the deaths in our opinion. At the same time it must also be noted that of the series of 10 deaths out of 18 cases 1 lived 10 days. 2 7 days. 1 3 days. 1 1 day. 2 12 hours. 1 1 hour so that in all probability 4 of these 10 deaths at least

may be attributed to shock. A waiting policy and the employment of means to combat shock could scarcely have given worse results. In 8 cases the condition of the patient prior to operation is not stated. Of these 2 died without operation. 1 died on the table. 11 recovered and the remaining 14 died making a mortality of 50.2/13 per cent. Two cases are said to be in good condition. 1 died. 5 in fair condition died. 5 in shock all died. 7 in poor condition recovered. 5 died. Of these deaths one occurred on the table, one immediately after the abdomen was closed and the other 3 soon after operation so that shock could be said to have played a part if it was not the sole cause in at least 5 of these deaths particularly since none of them died of hemorrhage.

This only emphasizes our contention that the patient that will not react from the shock of his original injury will certainly not withstand the additional shock of a prolonged surgical procedure. In this is to be found the explanation for our high mortality rate. This is the lesson that we desire to drive home. If shock and hemorrhage could be eliminated in these cases very few indeed would die of peritonitis and the death rate would be reduced at least 40 per cent. A knowledge of the blood pressure and a hemoglobin estimate might aid the surgeon in his decision to operate or not operate.

From the appended tabulation it is noted that the ileum alone was perforated in 11 cases the maximum number of perforations being 10 the minimum or a total of 48 perforations. Ten of these died. 1 recovered.

The mesentery in addition to the intestine was perforated in 7 cases the maximum openings being 4 in one case. 3 in one case. 2 in 3 cases and 1 in 3 cases. Of these 6 died. 1 recovered. Three cases were shot through ileum and urinary bladder with a total of 13 perforations all three died. The splenic flexure was perforated in 3 cases in conjunction with perforations in the ileum in 1 case and the jejunum in another. Both died.

The ileum and kidney were perforated in one case which died. The ileum and sigmoid flexure were perforated in 3 cases both

died. The large and small intestine was perforated in 8 cases with a total of 80 perforations with 3 recoveries and 5 deaths. The colon alone was perforated in 3 cases both recovered. In Bowlby's cases the colon cases furnished the highest mortality. The liver alone was perforated in 3 cases. All recovered. The stomach and liver were involved in 2 cases. 1 recovered. 1 died. The liver and kidney were perforated in one case which recovered. Of the 38 cases in which the hollow viscera were involved the mortality was 10.17/18 per cent. Of the 5 in which the solid viscera were involved liver, spleen and kidney all recovered.

This corroborates the experience of Barber during the siege of Kut as well as Walters, Rollinson, Jordan, Banks and Sir Anthony Bowlby in the battle of the Somme who reported 500 cases operated upon. Bowlby emphasizes this point as follows: "I would especially emphasize the advisability of leaving alone almost all patients shot through the solid viscera particularly through and through the liver for I am sure that I have more often seen harm than good come of surgical interference."

Case No. 6 brings up the question of diagnosis. He had been shot 24 hours ago. His condition was so good that penetration was doubted and he was kept for observation. Blood began to pass in his urine. He had hematemesis and showed evidence of peritonitis the next day. He died 4 days following operation. Earlier operation might have saved his life. But the question of diagnosis is constantly coming up. So frequent did this arise in the Bowlby series that an observation ward was established for them. If there is doubt as to whether a hollow viscus has been penetrated the condition of the patient being good make at least an exploratory puncture which will do no harm and should it reveal indications of perforation repair may then save life.

In rigidity, tenderness, distention, the character of the respiratory movement, the temperature, pulse and respiration, vomiting, the character of the urine and the general behavior of the patient must be taken into account. The bleeding patient is restless.

and air hungry. The shocked patient is listless and lifeless. A rising pulse rate particularly in the absence of fever is an indication for operation.

Secondary shock is only too often seen in these cases. It may come on in 1 or 24 hours after operation and usually ends in death. Salines, strychnin and other stimulation seem useless. Case 15 showed this likewise. Case 42. Southern surgeons no doubt on account of superior opportunities to study these injuries have established definite principles of surgical procedure which are now generally recognized. Hunter McGuire in 1873 and J. Marion Sims in 1881 made clear the fact that a perforative gunshot wound of the abdomen was a surgical condition demanding surgical treatment. In spite of the statistics of the Cuban, Philippine and Japanese wars McGuire's teaching is the teaching of today. Nothing has been added to it; nothing can be taken away.

Service at the Memphis General Hospital for about 18 years has given us ample opportunity to treat a large number of these cases. A conservative estimate of 50 cases a year would give a total of 900 cases treated during this time. From this rather extended experience the following conclusions are justified.

CONCLUSIONS

1. Perforative gunshot wound of the abdomen is a surgical condition demanding surgical treatment.

Shock is a contraindication to immediate operation.

3. Shock is the prime cause of death in these cases.

4. The patient being in good or fair condition the sooner operation is done the better.

5. Active hemorrhage unless coming from the liver demands surgical interference irrespective of condition.

6. Wounds of the liver alone had best be left alone.

7. In doubtful cases the condition of the patient permitting perform exploratory puncture under local anesthesia if need be and if hollow viscera are perforated repair them under general anesthesia.

8. A few moments thought as to the probable course of the bullet will furnish a fair estimate of the injury as well as indicate the site of operation in most cases.

9. Bullet holes are valuable for drainage tube.

10. Drainage and counter drainage in these cases is conservative surgery.

11. Lavacration is to be condemned. Internal inspection from a fixed point and closure should be the rule.

12. Early evacuation of the bowel is the rule in favorable cases.

13. The introduction of 2 ounces of concentrated solution of epsom salts by means of a catheter inserted into the bowel through the highest point of perforation may by favoring early evacuation allay the tendency toward paralytic distention which is always present more or less in these cases. The same result could be accomplished by injecting the solution into the bowel by puncture with a needle or it might be left in the stomach after giving it a thorough washing at the close of an hour.

14. Catgut good smooth fine and chromized for through and through approximation is best.

15. A hemoglobin estimation may help in the differentiation between shock and hemorrhage.

SUMMARY OF 50 GUNSHOT WOUNDS OF THE ABDOMEN

N d Ag	Loc t f I j ry	Ope s of Fnt	T m f I j ry	C dnt f P u t	I	Op t F d gs	Ope t I f r m d	C mpl t	R lt
8	Ep gastr m		5 b rs	T mp 16 P ls 4 Resp 6 R gid T d				V m t g blood lb m d d ast n	N d th h w th t p t o
36	L l w mbl 3 h t l ft A th right h p b l w g t t ocha t			Full f oc ry h d t t l	L ft ect	h l m l t ft f l m h l bl dd	S t d w th l S p p b cyst t my f d y g	Blood n	D d i bl
6 3	R rht h p th h l m t n g abd m		F w h rs	Pulse 4 T mp Abd m d t d d	S p p b	F blood 3 m ll peni gs es. l N test l pe t	P l dr d		D d d y l t w th lb m d t un
5 4			hours	P l turn T mp 070 R p s M h p	M d p mbl l	p f t j j m d l um h l m t ry	Cl d w th l 3 d t bes	Shock d f l l g pe t	D d g hours ft pe t
6 34	hes bo ymphy ss d t th f ft	Abo t f l h m po t n ly		P lse 6 T mp R gid T d I nt t	M dia pra p b	h les in l w l m L g h l pl m fl l	Resect d h f l m d b t e f l Murphy b tt		D d 3 day
5 7	f mal Left f mb pg s- tr m h l right hest ght l mb		Few h rs						D d w th t pe t 500 ft dm
5 5					Medi p gastr	C mpl t d va f d od m t pyl n jun t	E d to-e d ast m T be drains	C der bl t Bull t p ty loose	Death oo ft r p r t
35	f t d l ft p p l	Lev l th d l mbr r r h sp right f	h	E t m hock		Desc l d m t ry t rn b dly	Resect f 6 hes with lateral t mos	V na w d d l leed g w d gnos d	Death oo ft r ope t
8 3	Left l mbar		7 hours	F	L ft ect	H l l ft k d ey f l pl n d xz Iso j j m B l l loose pent l vity	Cl with catgut C u t pe f drai ag l D ainalg pel		Death 8 hours
9	B k h bo est f l m d 3 f m p				M d ep g trn	h les i ppe leum m vent ry	Clos with pl tgut f rced with lk l test clea d with od T b d a		Death i d y
5 39	f hes bel w mbl cu l ft l w q dra t				M dia ep gas	Upper leum d ded H l l gm d	Resect with M rph butt S xm d losed with l en		Death t bl
38	Above mbl cu d t th ght Also l ft rm bo wri		hou	F cond t	Median ep t	h les in ppe leum H l l wter pol f right k d ey	Closed with l Cou er dra i right fl a k	I su separat d g d y lter oper t Recluso w h th gh d through l worm gastr d ainalg kac l f t la posteriorly	D th 6 d y lter first operat

N ^d Age	Loc f ry	Open g f Exit	Tim f ry	C dut f t	I	Ope t f du g	Ope tu f f rm d	C mpl t us	Res
3 F m 18	Righ b tock		4 h ur	Abd m d du ded	V d p b	F blood d f l m t iso l d b l i d m has b l	S B l p nc ur d t all gas ac pe les d ar		D h bour
8	h l p g h e k			Shock N p l				llood d loc l m t t m g g f m w d	D h h t p t
6	Abd uml l	Righ l mb	h ur	P edity D ll ar	M d	F ee blood d f cal ma 7 pe t u ns m l l t 3 mese ry	S d h b l n f d b l lber les f d	S hock	D h 8 h
7 35	L f u t ly			Good	I f ec	h les d pe h m l	Clos S h h l t d	P ni	D h 7 d
5	A umb l y bo d i eck		h ur	f ur	M dist	l l t an l l b l mall t h les mese ry	C l T be dr n x T be pel		D h h
	B k l f f in	B th L ng g l gh	Abd t h ur			8 perf t g d m ll gu m ry	Clos be f d		Rec ry 5 day
9	I l it b k and des 3 mes				Le ec us ppe	P r d of po m h h les sm ll es	S d h l be f drai h d n y po h drai d		Rec ry 5 d
F mal 5	Low l f ngunal g		d y g			b les l g bo l l f fall p b pe t d	hes f l m so d L anas mos L g bo l t d		Rec ry m 3 d
3	B k f mb h l f f f mb rt b e				R ec	b les sm ll tes	Clos ca t		Rec ry
7	Left lumb g				Le ec t m f margi d ard	Splee p d E pe m l h m m l	H m rth t lled h pa k Le l dra l po		Rec ry
6 7	Fp ast m t gh f med Right f earm th gh d hr h f Radi		h ur ?		M d p	Lo mar m l f l be f l f blood b l edu h les pyl d l m h	C l ur th l S p b drai l d h h bull w d	P nitis	D h 6 d
6 4 37									Rec d
7 4		Rec is f	hes	es m f l					Rec d m 8 d h
36	Abd po p f l m A h l w d r l bo m d d l f b k	A t pe p f h m bo t res l l f h b							R h ry pe

GOLTMAN GUNSHOT WOUNDS OF ABDOMEN

23

N _d Ag	Loc t I j ry	Ope g L t	T m f I j ry	C d t P t t	I	Op t Find g	Ope t I r f m d	C mpl t	R lt
43 7	Abd mb l t t ght	B k bo e l t	h h	Pul e f C j t f	M d	Abd m full f blood l t Fae l m t t p nt h les m ll t h l d sc l	Cl w th l n t l l sal	Took æ th t c b dly	D th soo ft op t
4 7	hes bel t l ft	ll est h t ght f p	8 h	Abd m d t d d t d l l f G l d t fau	M d	F bloody fl d 6 h l l m l oæ l J 4 h l j j m d d m	Cl w th l t b d fl k d pel		D th 3 h
7	L ft d f ld m		5 l	Shock l l	M l	F bl d 5 h l d l 7 h l t p j j h l t P l F ll bl dd l t d	S t D th g l p t l d l th gh l r l f l t sal	F o	D th 3 h
9	M B y po t		h	Shock R ghar t R g d p ght f g C ld l mmy P l d l	M d n	I blood Cæ m p e f t d Sgm d p e fo t d Hem t m f t p t m	Cl w th l D d t t l d po t ly ly	F R p 46	D th h
Fe- m l 7				Shock ry t d Pul k d	M dia	F blood 7 perf t l t t dh t t ld py lp	Clos		D th f w h
34	Rght lia egi		4 h rs	L p dry p b d t d gnd ty d t t T mp 97-4 l l Resp 4	M di	F blood M y p e f t	Resect l 6 h m ll 4 hes fl g test	P t t s p t	D th oo ft bd m l d
44 7	L k l l of t p 4 hes from m dl	U d k t l w m g f l	6 h	Shock R gnd T d d G t p	Rght ec	A di g l perf t d	C l d f m t p e t l p d b h les p d th t gnt D th gh b ll t w d th th gh l		Rec ry
	B l w mb l c us l ft hes t t		9 h s	Pul oo pl R g d l m t g f	M dia	Fæe blood d læces h les i pper d m t na. l	Clos 3 t bea f dra g		D th 3 h rs
33	l ft h d t p p f d m		3 h rs	Shock l t t d St m h f ll f for l	M d	h les m ll test	Cl t bes l l ft	I separat d fifth d y R los re t ta ed lb m l ca t	D th i 7 d y
36	Cec t f l m			N hock Temp oo l læ 8	Rght rec	M y p e f t p p e l m	R sect f ft t t t d to-e d tamos l t enou t be f d		D th 7 d y l t lostrn rtem A t mos Mese ter th ombes Bow l l l l

N _d Ag	Loc _t I _j ry	Ope _t E _t	T _m I _j ry	C _d P _t	I _{ci}	Ope _t F _d g	Ope _t P _t rm d	C _{mplic} na	R _{ul}
5	M d l b u w m b l		h	P l s e p d R d k U bloody	M d	f blood M perf ns Bl d d pe f t d	3 f l m es d M rphy b p f w h l u bl d d t d A p e d o o m y t t f D a n o g	Bl d f o m e c u m	D h 3 h r s
	3 s h f m l		b ?	T d K s d d P r t o n a	M d	F blood M k d p M y p e f A p p e d i x by bul	C l A p p e d t m y P f d a i n d L o d r a i d	D N b o l m m t	D t h d a y
8	L f l m b l			T m p o b f l w k 68? R p 40	M d s	h l e a l m h i b l d d e r	C l o s D g f p e l		D t h h r s P h m t m H m h g P o s t d e e m p e r f t e d
8	L o u l f d f l f r m	B l k d y	8 h u r	T m p l l k R p E d D t d d V m g	M d a b	l d k blood f b y h l s m l l h l d s e L o o k d l k d h	C l u r P l i s a n d l d r a i d		R y 3 d a y
?	L e f l m b a r w h h g u		h	P u l s e o o f o o d l m h r f b s e r B l o o d p d H m m s	L f t t	f e e b l o o d N u m b e r f m l l h h m d y M y m a l l f f n s m a l l e s d d e s c l H m m l i k d e y	C l d	P t m	D h d y l d b b e h b h p e h s e t D g u d f i u l
?	R i g h t b t o c k	3 h j o m p h y	F w h r s	R g d F	M d u a	F e e b l o o d d f r f t m a l l t	C l o s u r t h g u t	P t m	D h d y
3 ?	L e f t d r t l s o h e a b s e f h r t l b k l h t w d s h d g h t r m f h m		F w h	V r y p o o	M d	F e e b l o o d p r f n s	C l o s u r O C l d a u		D t h h u r s h f m g b o c k
3 ?	E p s t r m t h l f a l s o l i f b o c k g h t h h l f h g b		4 h u r ?	P o o A b d o m p f l d d d d	M d	F e e b l d F a c e l m t h l e s s m a l l h l t l l l l d s e	C l o s D d c o d	P t t	D h 3 h u r
	S c p u l a r l b e R h t f k b e l w h b M d i a l b i L e f t f h o s t l r t g l i t b o u l d f t r m p d l i f m l d g h t l l f r m l f t l g m d e l l		h	U f r a b l S l g h b o c k P l	L e i t e c b u m b l	h l L e l h d b l d d	S m h t d L b m e L o d d S b d r a i		R e c d

N ^d Ag	Loc t f I j ry	Ope f g E t	Tim f I j ry	C du f P t t	I ciso	Operat F d g	Ope t P r f r m d	C mpl t	R lt
45 7	R ght hypo- h d r m L f t h d f c t d M t a r p l b o	B k d k	8 hou	N hock P l good	Koch	A t b l d g i f t l b f l p r f t d R ght l b l r a t d	L t l h a m r r h a s	I f e c t l h d	Rec r d
4 7	R ght hypo ch d r u m		6 ur		R ght ect	F e e blood B u l t t d d m f l u d m g d t l w m r a i A t b l d i n g	L p a k d R m d o s t h d y	S y n h l u 3 + W s s m W d p t d o m t h d y R t e d d æ t h e s	Rec red
?	B k s h f m p	A t r l y	hours		Koch	G l l bladd d h c o t d f i l l d w i t h t F b l o o d L f t l b l p e r f r a t d l l w p o l f k i d n y l m t t p l v i	L e l o s d w t h m t t e s l s o k d y D i p o t m l y G l l t e s l f t d t b d	G l l t e s	Rec d

DEPARTMENT OF TECHNIQUE

THE TREATMENT OF FRACTURES BY SUSPENSION AND EXTENSION

By J. E. CANNADAY, M.D., F.A.C.S., CHARLESTON, WEST VIRGINIA

FOR the past two years I have been making routine use of the principles of suspension and extension in the treatment of my fracture cases at the Charleston General Hospital. The principles of suspension and extension as applied to fractures are of course very old but until lately they seem to have been used but little. The treatment of fractures has fallen somewhat behind in the race and it is only recently that there has been a great revival of interest in this line of work. The great European war has given a tremendous impetus to the scientific treatment of all kinds of fractures.

Suspension and extension in the manner in which it is now carried out gives early and frequent mobility to the joints of the limb involved. The patient can get the benefits of passive motion from the beginning of the treatment. The apparatus is easily manipulated. It can if desired be so arranged that the patient can

vary the elevation of the limb to suit his comfort and convenience. The nursing care of the patient is rendered much easier and the number of nurses is reduced to a minimum. One nurse can dress the wound in a compound fracture with ease to herself and comfort to the patient whereas in the usual way supporting splints often had to be removed, the limb handled and two or more nurses were required. The fractured ends of the bones were moved, the work was hard and the suffering of the patient was severe. With the present suspension appliances the patient has a maximum amount of freedom in bed. He can shift his position with ease either laterally or lengthwise. The difficult maneuver of the bed is rendered easy. In practice the various supports described render the nursing incomparably easier. The wounds can be dressed and the bed linen changed by one attendant and the bedpan used without annoyance, pain or discomfort.

One of the very greatest advantages of suspension is that in the average case there is little if any swelling of the injured limb. The position is favorable for the return circulation, the prolonged water logging of the tissues with its

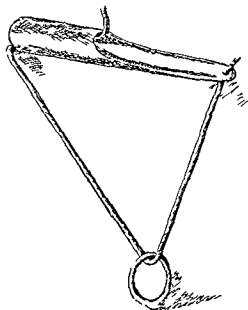


Fig 1 Tent key to correct suspension and extension

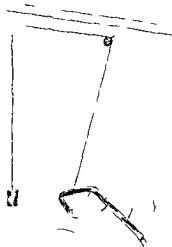


Fig 2 Apparatus for forearm

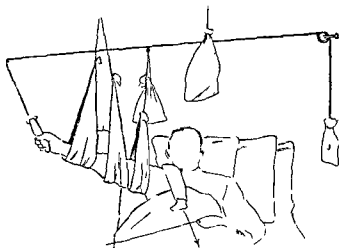


Fig 3 Frensdorf apparatus for giving support and exercise to the muscles of the fractured arm

malign influence on the periarticular structures is avoided and there is consequently less of the stiffness of joints than is usually seen in fracture cases. The suspension traction method by reason of its comparatively perfect immobilization avoids the excessive callus formation often seen when fractures are treated by the aid or rather in spite of many of the usual so called immobilizing splints.

In the treatment of fractures there is great latitude as regards apparatus. If the mechanical means are very limited a pole or broomstick placed longitudinally above the bed the foot end elevated the limb swung from this by cloth slings a padded board or splint placed underneath gives more comfort and stability. The extension can be made in the usual manner by straps of adhesive plaster pulley and weight. The amount of weight required will be much less than when the limb rests on or in the bed clothes as the drag of friction is done away with.

A bed manufactured with special equipment for fractures is not necessary. A sort of chassis is erected over the ordinary hospital bed by lashing an upright to each of the four posts. A cross bar at each end near the top supports the ridge pole which is movable and is lightly notched on top so as to secure the pulley block in any desired position. Several small blocks are required and a supply of light strong and flexible cord such as the curtain cord which can be obtained at the dry goods stores. The limb is supported by strips of heavy canvas 4 to 6 inches wide and 18 or 20 inches long. Each end of this strip has a hem wide enough to contain a straight and rigid stick. In each end of the stick is a hole for a ring or cord. The limb is then suspended as in a hammock. The suspension

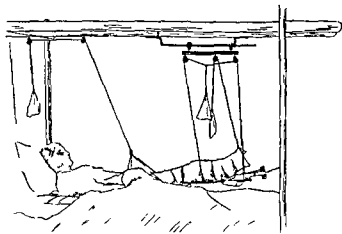


Fig 4 Overhead trolley for bed support (Blake)

should be nicely balanced by weights of the proper size so that if the limb is raised or lowered it tends to remain in its new position. Where desired it is fixed in position by a tent key the metal type used by the United States Government or the wooden key in common use. An economical and effective weight consists of a canvas bag with two strap handles through which the cord is passed. This receptacle may contain an assortment of sand bags varying in weight from five pounds to half an ounce. A hand support (as shown by Lyle) swung from the ridge pole after the fashion of the straps in street cars assists the patient in shifting himself in bed. A spiral spring or ordinary pocket spring balance is incorporated in each unit of suspension and extension so as to make the pull more elastic and thereby avoid shock and jars.

In speaking of the treatment of fractures of the femur by the use of the long splint in general use Hev Groves () says

It is dirty uncomfortable does not keep the patient or his leg really at rest though it restricts him by many bandages it does not produce either extension or alignment but effectually prevents both. It makes the nursing of the case heavy in the extreme and the man suffers a misery every time the bedpan is used the patient and splints have to be lifted or rolled every time the dressing is done the splint must be removed and then reapplied.

The dressing of the bad cases in the early stages requires four people and occupies from half an hour to forty minutes. One person does the actual dressing, one undoes and re-applies bandages, one holds the limb and one holds the patient and tries to mother the shrieks with which he encourages the man in the next bed who is awaiting his turn.

Wards containing many such cases tax the time, physical strength and moral courage of the nursing staff and they remain congested for weeks and months while the fractured femurs drag on their painful weary course.

It seems to me to be unnecessary to discuss the pros and cons of the immobilization method in any detail. It has absolutely no merits except the ease of its material provision and follows current textbook teaching.

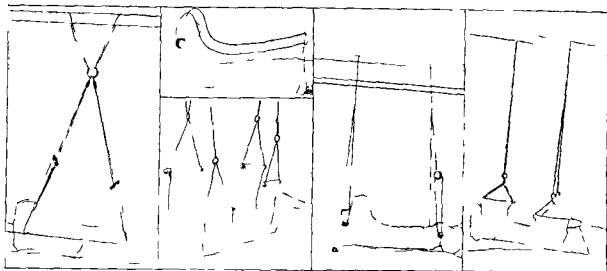


Fig 5

Fig 6 (bo) Fig

Fig 7

Fig 8

Fig 5 Support of foot
Fig 6 Apparatus for foot
Fig 7 Apparatus for foot
Fig 8 Apparatus for foot

Fig 7 Apparatus for foot
Fig 8 Apparatus for foot
Fig 9 Apparatus for foot

One of the more recent modifications of the suspension apparatus as shown in a cut from Blake's clinic at Ris Orangis (shown in my own work) an overhead trolley arrangement by which the patient can move longitudinally in bed with great ease. A stout stick is suspended overhead by two pulley wheels which travel on an iron rod in lieu of a track. The leg splint in turn is supported from the stick. This apparatus is suitable for fractures of the leg or thigh and can be used with almost any of the splints that are adapted to the suspension form of treatment. A modified Bucks or other form of extension can be used with this apparatus being attached either above or below the knee. The Dodds Parker suspension device described by Davison (3) is more elaborate but accomplishes a similar result.

The supporting splints for the leg and thigh are numerous. Blake's which is a modified Thomas consists of two light parallel rods one for each side of the entire leg. The two upper ends are joined by an oblique padded ring one side of which presses against the ischioperineal region and the other against the trochanter. The pedal end has two cross bars both of which are movable and can be anchored with set screws. On one side is mounted an adjustable foot piece. To this the foot is secured and extension is maintained and regulated by a double threaded bolt with a handle suggestive of the automobile

crank by turning the cross bars are approximated or separated as by a turnbuckle.

The railway plant bears a close resemblance to a flat car mounted on a track at the lower end of which is an upright yoke to support the foot. The track is partially fixed by overhead suspension while the car moves longitudinally on the track giving the patient liberty of motion along the length of the bed as well as from side to side. This plant is bent at the knee so as to give the position of semiflexion. The extension passes over a pulley fixed on the cross bar between the ends of the track and is maintained by a weight or by a small wheel and ratchet.

Among various leg splints in use are the modified Cabot with an upright foot piece and an angulation at the knee, the ordinary so-called Balkan splint which is a light rod of soft iron. At the knee this rod may be straight or angular. The perineal end terminates in a T bar which when well padded rests against the perineal and ischial regions serving the purpose of extension as well as that of steadying and fixing the limb. The outside end terminates in a similar manner and rests against the side of the pelvis just above the surface prominence of the greater trochanter. This simple splint is supported by having it attached to the sides instead of the top of the lateral rods making the splint suitable for either leg by reversing it. The upper end of this splint is modified variously. A complete circle of



Fig. 6. Mittendorf triangle plaster cast for fracture of humerus.

metal is sometimes placed between the two bars. This circle may be placed obliquely so that the outer side will come above the trochanter. Sometimes a pad or wedge of felt or other resilient material is inserted between this ring and side of the hip so as to bring the main pressure-bearing surface of the inner side of the ring more snugly in place or the metal piece at the upper end may constitute only a half circle crossing the thigh posteriorly for the pressure extension against the greater tuberosity which is by nature equipped to withstand pressure. A half circle of metal may connect the two rods anteriorly at the middle of the thigh also at the mid point of the leg below the knee. The foot is secured to the cross bar below it either by the customary adhesive plaster strips applied laterally to the leg with a perforated block for a spreader to protect the malleoli or by the method described by Dr Edward Martin at the Clinical Congress in Philadelphia in which the extension is made by imbricated adhesive plaster strips applied over a cotton sock. The free end of the adhesive strip are brought together in the instep of the foot and twisted together into a cord which is attached to the foot piece or by a spiral figure of eight bandage. A traction cord with light weight is attached to the foot bar. All cords are placed over pulleys so as to avoid unnecessary friction.

The fractured limb may in some cases be supported directly by imbricated sling or hammock suspended from the lateral bar of the suspension splint now in use but generally the patient is more comfortable and the results are more satisfactory

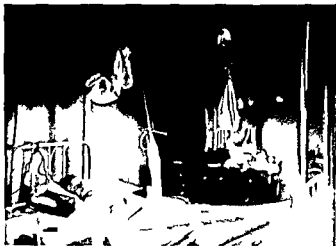


Fig. 7. Apparatus for fracture of humerus.

when the affected segments of the limb are supported by well padded splints of basswood, yucca or compressed paper splint material laid in these hammocks. All of these are pliable and are readily curved to fit the limb. They are light and give the necessary support to the fracture. Most of the old style metal and wire mesh splints cannot be satisfactorily used in connection with the modern suspension and extension treatment of fractures.

It will be noted that with most of the apparatus the leg is put in a position of flexion or semiflexion. This does not in any way interfere with Buck's extension being applied to the thigh or with the Steinman pin extension.

In the treatment of compound fractures the lesions of the soft parts must receive particular attention. The ideal treatment would be exposure to the rays of a sub-tropical sun and the avoidance of dressing. This out of doors treatment is of course impracticable in many cases and we must have recourse to artificial light. A cluster of electric lights suspended over the wound keeps the part warm, dries out the wound, greatly diminishes the amount of pus and promotes healing. The dried serum which accumulates on the raw surface from time to time can readily be removed by the use of compresses of Wright's solution (sodium citrate 1 part, sodium chloride 3 part, water 96 part). The electric light method has been used most extensively and satisfactorily by the American Ambulance and more recently by Crile (4) at the Lake Side Hospital. I have made use of the light treatment for open infected wounds extensively for the last two years and consider it invaluable. The absence of all dressing cuts down the amount of discharge from open granulating wounds to less than one-tenth of that

A SIMPLE METHOD OF PERFORMING EXTERNAL PERINEAL URETHROTOMY

B. J. DILLINGER, BARNY AND FACS, B. T.

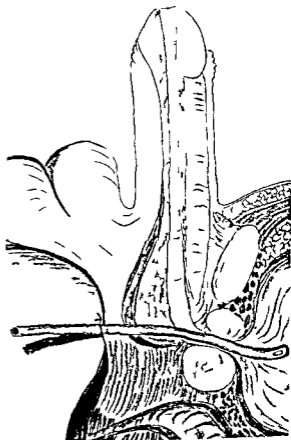
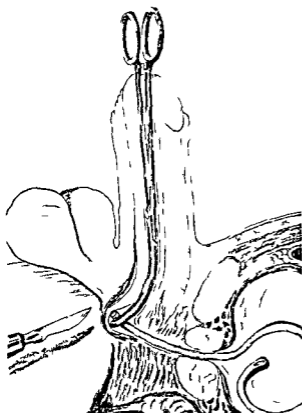
1 h C 15 D 1 m M 1 G 1 H 1 1

THE method to be described for performing external perineal urethrotomy is applicable to those cases (not at all uncommon) in which it is desirable to divert the urinary stream through an indwelling catheter from the field of operation until the wound has healed. It is so long a time before the urine should not come in contact with them. Such cases will include amputation of the penis and plastic operations for the relief of epispadias and hypospadias.

It is not intended to be employed for the relief of stricture of the urethra where a large incision and sometime extensive dissection is required. Neither is it intended to offer an easy method

of establishing a permanent perineal urethral fistula for this operation to be successful must be done in quite a different way.

To perform external perineal urethrotomy in the cases under consideration where it is desired temporarily to divert the urine from the operative field in the usual manner by cutting down upon a sound, grooved staff and then passing a catheter into the bladder through the wound require a long incision more or less dissection and the consumption of considerable time. By the simple method here presented the catheter



1 1 L 1 t d 1 t n 1 r t l 1 l l d d
l r g t h t r p l d k p d t h t t f
r y d c l p h h t l t f t l p l m d y
b u l l t h m d e t s e T l k f l
t d d t t t h p t t t h f m j

1 k 1 d 1 b 1 d t t l 1 b 1 d
t h r g h d d l m t p l d y f t t h g t
d a g b t t l

may be adjusted in the bladder and led out through the perineal wound in a moment or two.

A soft rubber catheter well lubricated and of suitable size is passed through the penis into the bladder in the usual way but it must be inserted until the outer end of the catheter is almost level with the external meatus or the end of the urethra (as the case may be). The catheter is then seized 0.5 centimeter from its outer end with a half curved clamp of appropriate size and length. The clamp is then passed down the urethra its convexity against the roof until its point is felt pressing against the floor of the bulb. The catheter has meantime been pushed ahead of the clamp and coiled in the bladder. The point of the clamp is now made to impinge against the perineum bulging it outward in the median line (Fig. 1). The urethra is then opened at this point by an incision which need not be more than 1 centimeter in length and the end of the clamp still grasping the catheter easily merges through the wound. The amount of bleeding is negligible and generally needs no attention whatever. The clamp is now opened and withdrawn upward through

the urethra and the catheter meantime is drawn outward through the perineal incision until its eye lies correctly in the bladder (Fig. 2). It is then secured in place by a coarse silkworm gut suture passed through the edges of the perineal wound and tied tightly around the catheter. Constant drainage of the bladder is then established by connecting the catheter with a bottle by the bedside or simply by letting it lie in a urinal which the patient keeps between his legs in bed.

We have employed this method of perineal urethral drainage for several years and in many cases always with great satisfaction. The advantages claimed for it are:

1. Ease and rapidity of execution.

A very small perineal incision which closes almost immediately when the catheter is removed.

3. The amount of hemorrhage is negligible and generally needs no attention.

4. It may be performed at least three times at different intervals in a given case and without increasing difficulty.

5. There is no evidence that it is followed by stricture formation.

THE ACTION OF RADIUM ON CANCER

BY HENRY H. JANEWAY, M.D., NEW YORK.

DURING the past three years the Memorial Hospital of New York City through the generosity of Dr. James Douglas has possessed an unusual opportunity for testing the action of radium on cancer. Approximately 42 cancer patients have been treated in this period with radium. The vast majority of these patients have been treated within the last two years as before this time a small quantity of radium was available and few patients were treated. Between three and four grams are now in use.

Until comparatively recently practically no attempt has been made to select patients more appropriate for treatment; few patients with advanced cancer who applied for treatment having been refused.

A full discussion of the results of treatment and the detail of all important cases and method of application are furnished in the complete report published separately.¹ A summary of the results appears in the following table:

Radium Therapy in Cancer. A Summary of the Results. By Henry H. Janeway, M.D. New York: The Memorial Hospital, 1914.

Of the malignant tumors comprising this table two varieties have shown an unusual susceptibility to the radiactions from radium. These are the lymphosarcoma and the cellular carcinoma of the testicle.

The majority of patients with lymphosarcoma whom we have treated have either had a rapidly metastasizing tumor or came to us in a stage when their disease was already widespread. In such patients the most that can be accomplished is the disappearance of individual tumor masses. Such retrocessions nevertheless give the greatest temporary relief to these patients often prolonging their lives for a longer or shorter period in comparative comfort.

Two patients however came to us at a time when their growths were still localized. In both cases the sections showed very cellular lymphosarcoma. In these patients we have obtained a more permanent result. A year has elapsed since they have been treated and no recurrence has yet appeared. Freedom from recurrence for such a long period in such a malignant lympho-

sarcoma argues well for the future of the c patients and demonstrates that a cure may be a possibility in certain cases of lymph sarcoma when treatment is applied in an early stage.

The second tumor, having marked susceptibility to the radiations of radium the cellular carcinoma of the testis or ovary have given us the most remarkable result which we have obtained by the use of radium.

No patient illustrates this action better than the case of S. R., a little girl of twelve years who came to us on April 6, 1916, with a tumor as large as her own head completely filling the pelvis. It was hard and nodular on its surface and was considered at first to be a chondrosarcoma. The child received a single treatment over the abdomen and within three weeks the vestige of the tumor could be felt. There has been no recurrence to date. The diagnosis in this patient rests upon clinical evidence.

In the three patients the diagnosis has been confirmed by the microscope. Both the patient developed large glandular metastases within the abdomen secondary to a carcinoma of the testicle. The testicle in each case was removed in one patient before and in the second patient immediately after the treatment was applied to the abdomen. A single treatment to the abdomen in each patient caused a disappearance of the abdominal tumor and the patients have now been free from recurrence for periods of six months.

In neither affliction rhumex acts in almost the same specific manner. A like application will cause the retrogression of enlarged spleen in myelogenous leukaemia with a corresponding reduction in the white blood count and improvement of the patient's general condition.

It is probably the beneficial action in leukemia induced by any other agent. It is to be presumed that the result will not prove permanent in leukemia although just how long it will persist in leukemia cannot yet be estimated.

The effects of radium in many uterine fibroids have been so good that the fact deserves particular mention. In a patient for instance, two applications over the abdomen cured a complete retroversion of a tumor palpable through the abdomen half way up to the umbilicus, a cessation of the menorrhagia and complete restoration of her general health with utter absence of any erythema of the skin.

With single exception the remaining patients of this report concern cancer of the skin and mucous membrane. Its favorable action on

SUMMARY OF RESULTS OF TREATMENT BY RADIUM IN CANCER

	P _h	bel mp even	W ll k	l d m l	Imp	U d	P h l	l m l	T
1	1		4		6				4
2	2				3		0		3
3	3				3	4			
4	4				4	3			6
5					4		6		6
6					4		4		5
7					6		5		6
8					4	4			
9					3	3			34
10					4	3			8
11					3	3			9
12					3		0		
13								0	
14					4		6		
15									93
16					1	3	6		7
17					43	5	1		4

cutaneous epithelioma has been recorded. While the basaloid form of epithelioma of the kind frequent about the face yields most readily yet the squamous cell epithelioma of the kind in its early stage may be easily cured by single application of radium.

The cruce which radium perform in cutaneous epithelioma can only be appreciated by the new method of the horrible rascals wrought by the disease in the later stage. It is of the greatest importance to make the first treatment efficient. When this is done one treatment is often all that is required and the permanency of the cure is almost sure.

The service which radium can render in epithelioma of the skin is unquestionably great yet it is a service which in many of the cases can probably be a efficiently rendered by other agent chief among which is the X ray. On the other hand we have obtained apparent permanent retrogressions in cases previously unsuccessful treated by the X ray though of course it must not be forgotten that merely because a patient has had X ray treatment it does not mean that he has had efficient X ray treatment.

One of the first patients treated by a illu-
trates not only the usefulness of radiumtherapy
in cutaneous epithelioma but also the thorough-
ness of its action. The patient was an old lady
with an epithelioma one inch in diameter upon
the side of the nose involving the inner canthus
of the right eye. It was adherent to the under-
lying bone. Two applications of radium applied
three years ago caused it to disappear completely
without recurrence to date. It had previously
been unsuccessfully treated with the X-ray.
In this patient operation was of course out of
the question and no other treatment could have
possibly saved her from a progressive painful
destruction of her face and eye.

Great as such a service is a far greater interest
concerns the possibilities of successfully treating
cancer of the mucous membrane with radium.
The cancers are inaccessible to the X-ray but
in the majority of instances can be covered by
radium. The published report to date have
shown however that it is a matter of the greatest
difficulty to obtain really good result in the
treatment of these tumors with radium there-
fore instances of complete clinical retrogression
are noteworthy.

From the standpoint of radiumtherapy there
are two important forms of the cancer. The one
are the epidermoid carcinomata of the mucous
membranes of the nose mouth larynx and oph-
arynx and anus and the adenocarcinomata of
the stomach and rectum. The greatest interest
centers around how much radium can do for
these tumors in the case of epidermoid cancer
because no more malignant tumor is known to
be judged by its unchangeable progressive course
to death and the rarity with which it is cured by
even excision except in the earliest stages and
in the case of the adenocarcinomata for perhaps
the very opposite reason because they have
shown a rather marked susceptibility to the
radiation of radium.

When the clinical record of the patients
grouped in this table are studied the important
fact is developed that the favorable character of
the end result is inversely proportional to the
case with surgery to the size of the tumor treated.
Practically all the cases in the unimproved
column and the majority of those in the im-
proved column had advanced growths when the
treatment was begun. This fact deserves em-
phasis because it has become increasingly evi-
dent that if radium fills a field of usefulness in
the treatment of cancer of the mucous mem-
branes it is in the earlier stage when the disease
is still circumscribed.

In advanced cancer any temporary benefit is
frequently overshadowed by the later pro-
gressive extension of the disease in extension
which in at least epidermoid cancer though
more indolent is quite as progressive and painful.
We have been led to treat more of these patients
than we otherwise would because the beneficial
moral effect justified doing something for an
individual for whom there was nothing else to do.

It is important in undertaking the treatment of
these patients to recognize the character of the
end result to be expected and to plan the treat-
ment accordingly. No patient of this class
should be given a treatment which will be fol-
lowed by more than a transitory discomfort.
The administration of severer treatments will
only make the patient very uncomfortable for a
short period before his disease starts to do so
in a still more aggravated way than it was begin-
ning to do at the time the radium treatment was
begun.

When however we come to consider another
class of cases the more circumscribed growths of
the mucous membranes with which radium per-
forms its best service an entirely different
problem presents itself. Here a different end
result may be expected and it is good enough to
warrant pushing the initial treatment to the
point of producing considerably more discom-
fort when this is necessary than in the case of
patients treated palliatively and especially of
the smaller areas of tissue exposed to the
radium.

The character of some of these results are well
illustrated by the description of the lesions of
the more striking cases in column one.

1. Of the carcinomata of the lip. N. N. Ca. C. N. 22231
h. l. on July 10, 1903, a hard nodular ulcerated tumor
m. surrounded by the right corner of the mouth. The
growth is of an inch in diameter and in of about
inch of both the upper and lower lips. He received one
treatment and at the present time from his life.
3. Of the carcinomata of the antrum. T. T. C. N.
de. el. ped. a. r. cur. nec. in the cavity after the
excision of the posterior maxilla. On August 11, 1911,
there was an ulcerated tumor of an inch in length 3/4 of
an inch in diameter in the remnants of the anterior
all of the antrum. Microscopic examination found
carcinoma. The retrograde effect three treatments later
in the maxilla 10-19 in the retrograde effect
the maxilla turbinate bone had in the maxilla
the retrograde effect in the retrograde effect
the retrograde effect in the retrograde effect
3. Of the epitheliomata of the tongue. D. I. C. N.
on April 1904 had upon the left tongue in the
anterior part of the pillar of the fauces an ulcerated
tumor in diameter. There are no lateral
involvement in the neck. Microscopic examination
found carcinoma. He received one treatment to
the tongue and section of the tongue with neck. H.

le t gr d d h h b f f m d e
 4 Of th p th l m t f th t gu J D C N
 3 (4) had J o 9 6 p th 1 p u f c f
 tl t d l l t l t t p a d
 um te d m r f m l b t k m f m
 cal t l d f l y b t k Th e
 lympl t t l p bl t l k M t
 m t p d m d m O t tm t
 dm t d d h l g m j l t l y S t mb
 l th p t t l l l m l
 5 Of th t m t l th t l L C N t q
 l l J t o c f th t l b tl d i y m th
 bl l ted l t h d m t th b f
 h h ha t t l l y l t d Th d k f
 n m t l m d b v t c mpet t g H
 l th t m t l ft pa t t gh
 p l l p d f l m f t h l h d l g
 t t h f l k t t t t b tr f m
 d t t h f t l p t H f l
 b t th h h t y
 c Of th a f th t M l C N
 3 t J l O M h g e m t
 h d t t th l d l g l f
 l t d lm t th l l Th f e r f
 th ul w t p t t m l l c m
 t f th t t g l d pl f m l c m
 Sh d o t tm t Tl l h l i th d
 h g d d h h b f f m l l d f
 d a

Much interest concerns the treatment of adenocarcinoma of the stomach by radium. Cancer of the stomach is frequently of this variety and it is usually discovered in a stage too late for successful operative removal.

Though the number of patients whom we have treated is yet too few to warrant any statement regarding the degree of retrogression which may be obtained by radium in cancer of the stomach yet we have obtained notable reduction in the size of tumors of the stomach and in the subjective improvement in a number of patients by external application and in one patient by the application of radium within the stomach.

The improvement in the patient is sufficient to demonstrate that we have in radium an important palliative agent in the treatment of cancer of the stomach.

The cases above outlined of cancer of the mucous membrane are illustrative of the best

service that radium can perform. It will be appreciated that in the majority of them the lesion was small and probably operable but operation for one reason or another was deemed inadvisable or refused.

They all show what appear to be complete retrogressions. A complete clinical retrogression is not however a cure and the value of the present report will be small from the viewpoint of those who are accustomed to give serious consideration to only those patients remaining well after a three to five year period.

Nevertheless the character of many of these retrogressions bears a stamp of sufficient permanency about them to warrant stretching the indications for the use of radium far in the direction of the early cases. In cases 21 666 and 2271 of the superior maxillary group 2 251 of the lip and 1371 of the rectal groups the retrogressions have remained clinically complete for two years and over.

While the number of patients having retrogressions complete enough to suggest a cure forms a small percentage of the total number treated it forms a high percentage of the cases early enough to be classed as favorable ones for treatment. The vast majority of the patients included in this report as has been explained were so advanced that they are of no value as a basis for estimating the best results and certainly would be excluded from statistics of surgical cure.

The 21 patients who are still free from evidence of disease and in the care of whom one year or more has elapsed since their treatment were all with the exception of patients with inoperable cancer possible operable cases.

The total number of patients of a similar class treated many of them with a technique far from perfect up to one year ago was 29. Sixteen of these have therefore been free from evidence of disease for one year a percentage of 55.5 which justifies the treatment of certain selective cases of operable cancer by radium properly administered instead of by operation.

MODIFIED UTERINE AND VISCERA FORCEPS FOR THE CAREFUL MANIPULATION OF TISSUE¹

By ALBERT J. SCHOENBERG, M.D., CHICAGO

WHEN the need justifies nicety of technique and gentleness in handling tissue may be sacrificed for speed and safety. Tissue may be traumatized abraded and raw surfaces left and the possibility of adhesions disregarded when necessary to carry the patient through to safety.

On the other hand operations not vitally urgent such as intrapelvic reconstructive work for mechanical defects or for the removal of pathologic tissue not endangering the immediate life or health of the patient should be reasonably free from the danger of adhesions that may lead to serious complications.

A not infrequent cause of trauma to the abdominal and pelvic tissues is the injudicious use of sharp-pointed or serrated instruments which puncture and lacerate the peritoneal surfaces and invite adhesions.

In SURGERY GYNECOLOGY AND OBSTETRICS 1910 I described a rubber covered uterine forceps and in 1912 Wakefield described a uterine forceps similar to mine. The forceps here presented are a modification of my former instrument.

The new uterine forceps have been made to conform more nearly to the size and shape of the uterus the posterior blade being slightly longer than the anterior blade the shank of the handle bent forward and the width of the jaw narrowed permitting easier application to the uterus. The metal of the jaw has been widened giving a better holding surface and the forward bend placing the ratchet and handle out of the way of the operator when in use.

The uterine forceps are especially useful for holding the uterus when retrodisplaced facilitating any of the various round ligament operations or other intrapelvic work. They hold firmly and do not traumatize the peritoneal surfaces.

It was while using an intestinal forceps described by Barrett in 1904 that a part became

detached and was lost. This led up to devising a viscera forceps more simple yet efficient which also were described by me as stated above. Eastman one year later described a similar forceps.

The new viscera forceps have been made stronger. The metal of the jaws has been made slightly heavier and flattened. This increases the holding surface makes it easier to obtain rubber tubing that fits snugly and prevents rolling of the covering on the jaw. The space between the blades from the jaw to the lock has been widened to the width of one centimeter. This feature in the new forceps prevents compressing or pinching tissue beyond the rubber covered jaw. The steel has been so tempered that it holds firmly but without undue compression. Rubber covering or catheter easily obtainable is used for covering both the uterine and viscera forceps. The tubing is easily applied and cannot at an inopportune moment become detached and lost. Extra parts or specially constructed rubber fittings are not required obviating inconvenience and loss of time when replacement of covering becomes necessary.

The viscera forceps can be used to handle the intestines ligaments or peritoneal folds or any abdominal or pelvic viscera with little danger of injuring tissues. They can be placed over the

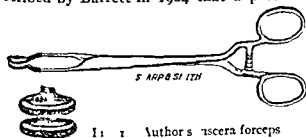


Fig. 1. Author's viscera forceps

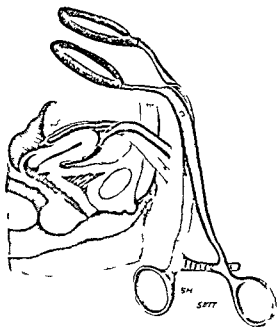


Fig. 2. Author's electric uterine forceps

Published by the Chicago Gynecological Society, May 9, 1917 (See p. 21)

tube without compressing the lumen of the tube or the appendix can be picked up without traumatizing the intestine should it by accident be

caught in the grasp of the forceps. They are safe and efficient and possess the important point of simplicity

EXPERIENCES IN THE GLASGOW ROYAL MATERNITY AND WOMAN'S HOSPITAL IN THE SUMMER OF 1916¹

By W. F. HEWITT, M.D., CHICAGO

THROUGH the recommendation of Dr J. Clarence Webster I had the opportunity of being a resident in the Royal Maternity and Woman's Hospital of Rotten Row, Glasgow, under Dr R. Jardine and Professor Munro Kerr.

Glasgow is a city of over a million inhabitants and chiefly engaged in manufacturing. Its slums are far worse than any I have seen in my four years work in the Presbyterian Hospital Out Patient Department. Partly by the corporation of Glasgow spurred on by Murdoch Cameron and partly by subscriptions this maternity hospital was built 7 years ago at a cost of 550,000 dollars. The arrangement, construction and equipment of this simple pure charitable hospital are the best I have ever seen. Some of the more striking features are

1. The building is a fine example of modern architecture, with a large central hall and many small rooms, each with a private bathroom and a private entrance. The building is surrounded by a large garden, and there is a large playground for the children of the patients. The building is very comfortable and the patients are well cared for. The building is very comfortable and the patients are well cared for.

2. The building is a fine example of modern architecture, with a large central hall and many small rooms, each with a private bathroom and a private entrance. The building is surrounded by a large garden, and there is a large playground for the children of the patients. The building is very comfortable and the patients are well cared for. The building is very comfortable and the patients are well cared for.

cl. Howard cranioclast I had hoped to exhibit this tonight but it has disappeared somewhere between Glasgow and Chicago. Owing to the number of contracted pelvis coming to the hospital in labor with dirty outside handling the cranioclast was somewhat frequently used.

The students took their cases while in residence at the hospital and received 7 normal cases before being sent to the district. Here they received 14 to 20 besides being called for the operative cases in the hospital.

Murdoch Cameron has an anteroposterior forceps which he uses with great skill. The other men always made a pelvic application of the forceps. The patient was not put in lithotomy position for forceps but the nurses held the legs so as to obtain the least stretching of the perineum. The knees were vertical for the application while for the head at the vulva the knees were flexed over the abdomen. The head was rarely delivered with the forceps merely a distention of the vulva was allowed and the fundal pressure was applied. The anaesthesia was invariably

chloroform. The use of ether was almost contra indicated by the prevalence of ether bronchitis. This was deemed to be due to chronic alcoholism. Episiotomies were rarely done as Dr. Jardine raised the point that most episiotomies are useless i.e. not needed are sources of infection and leave an external scar. His method of delivery in which the patient has a relaxing anaesthesia as the head is ready to come over the perineum and fundal pressure is combined with deep upward pressure over the sacral segment of the perineum is prone to give a minimum of tearing. In this procedure the head and the force is entirely under the control of the accoucheur. Gas was not advised for this stage.

Twilight sleep had been given a trial and had awakened no enthusiasm. It was not being used last summer. Nitrous oxide was deemed of no use in version or difficult forceps cases on account of lack of relaxation.

I wish to record my deep appreciation of the favor rendered me by Drs. Webster, Jardine and Kerr.

TRANSACTIONS OF SOCIETIES

CHICAGO GYNECOLOGICAL SOCIETY

REGULAR MEETING HELD MAY 15 1917 WITH THE PRESIDENT DR CHANNING W BARRETT
IN THE CHAIR

MODIFIED UTERINE AND VISCERA FORCEPS FOR THE CAREFUL MANIPULATION OF TISSUE

DR ALBERT J SCHOENBERG exhibited a new forceps (see p 37)

EXPERIENCES IN THE GLASGOW ROYAL MATERNITY DURING THE SUMMER OF 1916

DR W I HEWITT read a paper (by invitation) on his experience in the Glasgow Royal Maternity Hospital (see p 38)

CLINICAL AND EXPERIMENTAL STUDY OF THE EFFECTS OF CHLOROFORM ETHER AND GAS DURING PREGNANCY AND LABOR

DR CARL HENRY DAVIS read a paper entitled Clinical and Experimental Study of the Effect of Chloroform Ether and Gas During Pregnancy and Labor (see p 170)

DISCUSSION

DR JOSEPH B DE LEE Have you observed any hemolysis in the mother where nitrous oxide is given?

DR DAVIS No

DR DE LEE In the early days when I was enthusiastic about it I began nitrous oxide when the cervix was two or three fingers dilated in the case of one of our physician's wives and she had an acute hemolysis which resulted in an acute postpartum hemorrhage with a general icterus and bile in the urine. Since then I have kept down the use of nitrous oxide and have gone back to ether.

DR N SPROAT HEANEY Being an associate of Dr Davis I have followed him in this work and been very much interested in the result of his experiments.

Dr Davis was led to take up this study because of the assertion from so many quarters that gas is dangerous to the fetus and Dr Davis wished to find out if this danger were present and if so its extent. Among our obstetrical cases we have had a few cases of unexplained hemorrhage into the brain of the newborn and since these cases were given gas one phase of his experimental work was to find out whether gas produced changes in the blood. Dr Evans Graham some three or four years ago carried out experiments with chloroform in pregnant

animals and came to the conclusion that chloroform produced ulcers of the duodenum with resultant melaena and acidosis. The cases of hemorrhage into the brain where we have given gas were also cases to which we have given pituitrin. Where pituitrin has been administered during labor and afterward the child has a brain hemorrhage the possibility of the pituitrin instead of the anesthetic producing the brain hemorrhage is a question which has to be taken into serious consideration. When we first began using pituitrin (which was before we ever used gas as a regular routine in labor) we had several cases of brain hemorrhage in cases of spontaneous labor. Since we have begun to use gas these cases have not been increased in number. I believe that pituitrin is responsible for cases of brain hemorrhage more often than suggested for the following reasons. On effect of pituitrin is to increase the blood pressure. When the blood pressure increases the pulse rate is decreased. We have no direct way of measuring the effect of pituitrin upon the blood pressure of the fetus. Hence on the mother in labor but the observation that the pulse rate so frequently drops soon after the administration of pituitrin leads us to the conclusion that the blood pressure in the fetus is probably also greatly increased. In addition to this factor the increased intensity of the uterine contractions greatly compress the blood in the fetus. If a part of the head is protruding from the cervix it is not protected the blood in the head may be under such high tension that a vessel in the vessel may rupture and therefore produce intracranial hemorrhage or if very small rupture be present only manifest symptoms when the hemorrhagic tendency in the newborn appears on the third or fourth day.

Dr Davis has shown that there is some danger to the fetus from all anesthetics but the result of his experiments seems to show that giving gas for short periods of time is the least objectionable method.

DR CAREY CULBERTSON It was my privilege and opportunity to see an autopsy on one of the guinea pigs that died as a result of asphyxia. There were hemorrhagic changes in the organs which were strongly suggestive of some changes I have seen at a topsy following hemorrhagic neonatorum hemorrhage in the newborn. That rather suggests it seems to me that hemorrhage in the

newborn is a common cause or expression of asphyxia

With respect to the work of Dr Davis he has shown that the important factor in giving nitrous oxid in labor is the intermittency of its administration—something which is set aside by all of us who use it in the beginning and at the end. It should not be given continuously or it should not be given to make the patient cyanotic. Certainly since we have been using nitrous oxid in labor as far as the production of hæmolytic is concerned we have not had more postpartum hæmorrhage than we have ever had. In my experience we have had none. We have not had a postpartum hæmorrhage following the administration of nitrous oxid.

I have had but one case of hæmorrhage into the brain since I have been using nitrous oxid. In this case the scalp was ecchymotic and that patient died shortly afterward from hæmorrhage of the brain.

So far as the long continued use of nitrous oxid gas is concerned I have had considerable experience in using it during my ordinary laparotomy work, and I have not seen any evidence at any time and I have used it at least 25 times of hæmolytic or of excessive hæmorrhage, neither have I had these from any local or general anæsthetic.

DR DAVIS (closing). The question asked by Dr DeLee is rather a hard one to answer. I have never seen a patient with any evidence of hæmolytic following nitrous oxid. In the guinea pigs I asphyxiated with nitrous oxid undoubtedly there was some hæmolytic. I cannot believe there could have been so much hæmorrhage from the capsule of the liver without hæmolytic. But asphyxiation causes a complete change in the normal structure of the blood and it is only reasonable to suppose that we would get hæmolytic in such cases. We might get it from partial asphyxiation of any kind. There is always a possibility that we have a difference in susceptibility in different individuals. The guinea pigs under the gas anæsthesia demonstrated that there is a wide difference in the percentages of oxygen required. How much the tuberculosis present in some of those pigs interfered with or caused changes in the susceptibility to the anæsthetic of course I do not know. I believe Dr Holmes who is present has reported cases of hæmolytic where no anæsthetic had been given to the mother.

DR RUDOLPH W. HOLMES. In one there was a streptococcus infection, in another a pneumococcus infection, and a third one was unproved.

DR DAVIS. Showing that there are other factors which must be considered in connection with hæmolytic.

So far as death *in utero* of these young pigs is concerned under the liver of two stillborn young pigs I found blood clots showing that there probably had been hæmolytic with hæmorrhage into the peritoneal cavity. These pigs showed evidences of asphyxiation and from the work which has been done by Graham and others it seems very probable

if not certain that a good deal of the hæmorrhagic disease of the newborn occurs from asphyxiation at the time of labor. Now if you increase that asphyxiation by using pituitrin or by your administration of the anæsthetic you increase the tendency of the fœtus in utero toward a hæmorrhagic condition. Furthermore I think it is probable if not certain that a great deal of the icterus of the newborn is due to asphyxial changes during the process of labor. I would like to ask those of you who are doing cesarean sections if you will make careful note during the next year of how many cases of severe icterus you get following delivery by primary cesarean section. That is the only way by which we can determine that point. If icterus does not occur following the primary cesarean section where there has not been birth pressure we will have practically proved that at least most of the icterus of the newborn is due to some degree of asphyxiation in connection with the labor.

There are no statistics available to show that the use of ether chloroform or nitrous oxid increases the number of babies which are stillborn or die during the first week after birth. You will agree that probably in 60 out of every 1000 births in this country the children are either stillborn or die during the first week after delivery. If that occurs when most of the women are delivered without an anæsthetic before we can say the anæsthetic is causing an increase in mortality we will have to show that where anæsthetics are used more babies are stillborn and more die during the first week.

A COMBINED BACTERIOLOGICAL AND HISTOLOGICAL STUDY OF THE ENDOMETRIUM IN HEALTH AND IN DISEASE

DR ARTHUR H. CURTIS read a paper entitled A Combined Bacteriological and Histological Study of the Endometrium in Health and in Disease (see p. 18).

DISCUSSION

DR THOMAS J. WATKINS. I naturally have been much interested in this work. Dr Curtis has been doing. Recent observations which have been made in bacteriology show that cultures made from ground tissue as he has done are much more productive than when made from smears.

DR EMIL RIES. I believe we are all a little awed by the magnitude of the problem and by the magnificent way in which Dr Curtis has gone at it. If we consider the amount of work that is represented in the paper given us tonight we shall hesitate naturally to pick up individual points when in reality we have to deal with a fundamental paper the importance of which is as great as the practice of gynecology. I shall therefore prefer to say a few words which will give Dr Curtis an opportunity to tell us some more. In making such a series of investigations many incidental points are brought into the proper light and it is very interesting to compare Dr Curtis' findings with what is known

in the literature. While his work agrees practically in all essential points with Menge's, he did not tell us in how far his results agreed with the stages of the development of the uterine mucosa as given by Hirschman and Adler. He stated that in certain cases the endometrium was found normal. He further stated he accepted Hirschman and Adler's work, and when he used the word normal he meant probably that the cyclical stages were present in these cases referring to the stage of menstrual cycle. I would like to have him tell us if he can in how many cases his results agreed completely with the determinations of Hirschman and Adler. According to Hirschman and Adler it is possible from sections of the endometrium to tell approximately at what date the previous menstruation has taken place and at what date the following menstruation can be expected because they differentiate between the stage of quiescence, the stage of premenstruation and the stage of menstrual mucosa. All the workers on the endometrium have agreed with Hirschman and Adler in the essential points and each one has tried to pick a few cases where he could not agree with Hirschman and Adler. No, it is a common finding if you examine large masses of endometrium not only one or two pieces but the whole curettement, the whole endometrium to find that certain parts present the interval stage while other parts present the premenstrual condition. If the premenstrual condition prevail at a time when it should not do so at the time when the interval stage should be present we would have to deal with an unphysiological condition. If at one and the same time you have the interval stage and premenstrual stage in the same uterus that would not agree with the work of Hirschman and Adler.

It would be interesting to hear from Dr. Curtis whether in his extensive investigations especially in the infected cases and diseased cases he has found such abnormal development of the mucosa. I understood the doctor to say that only one piece was reserved for microscopic examination while the rest was ground up for bacteriologic examination. He may therefore have been prevented from investigating various parts of the endometrium and may have been prevented from finding such an abnormal development.

I would like to hear also from Dr. Curtis whether in the pathologic cases in which the adnexa were removed to a greater or lesser degree the bacteriologic and histologic examination was extended to these and how the findings in the tubes agreed with the findings in the uterus in so far as he has already stated them. This would be of great importance from a practical standpoint. In connection with gynecological operations the pendulum has swung a good deal in the last 20 years between the extremes of conservative and radical methods. At one time we removed the uterus completely with the tubes when infected. At other times we removed the tubes and ovaries and left the uterus. At other times we removed the body of the uterus when the

tubes were infected and ovaries. We have used this or that method according to our experience or personal liking. If in all these pathologic cases where the tubes were infected the endometrium was normal there was no reason to remove the body of the uterus and it would be proper to leave the body of the uterus in all such cases if the tubes are removed.

I heartily agree with what the doctor said about the nature of the discharge which is usually called leucorrhoeal as not being caused by the function of the endometrium of the body but rather by the endometrium of the cervix. It is a common experience that in cases of pyosalpinx for instance where the patient complains of leucorrhoea among other symptoms we remove the double pyosalpinx with the body of the uterus and the patient continues to have leucorrhoea the same as before until we do something for the cervix.

I would like to have Dr. Curtis tell us something if he can whether he has any experience with infection of the endometrium by the application of the tent. I do not know how many men there are in this audience who have used the tent. I have never used one in my life but I am working in a hospital where other men use the tent right along and in recent investigation which I made I found very distinct evidence that the tent is a fruitful source of infection. Aschoff pointed out a few years ago that in all cases where the tent was used there were signs of acute inflammation of the tubes. The tent does just exactly what Dr. Watkins mentioned namely it makes a wide opening a wide breach between the body of the uterus and cervix and vagina and makes of the whole cavity a continuous cavity with easy access of micro organism from the vagina to the body of the uterus. When the tent is inserted properly into the body of the uterus there is a pathway for the micro organisms clear up to the body of the uterus.

DR. CARL HENRY DAVIS. I would like to ask Dr. Curtis on or two questions first what is the relation between retrodisplacements of the uterus and the conditions found in the endometrium. What was the condition of the cervix in the two cases in which he found mixed cultures following the curettage?

Another point is with reference to the technique. I have for a long time in cases where I have had occasion to do dilatation and curettage where there is an ulcerated condition of the cervix taken particular pains to paint the cervix several times with iodine and in introducing the Hegar dilators at each time before introducing the dilator I dipped them into the iodine solution and then passed them into uterus.

DR. S. S. SCHUCHER. I do not feel competent to discuss the fundamental question of the paper but inasmuch as Dr. Curtis referred to a case of syphilis of the uterus a subject in which I am very much interested I will say that the case only five cases of syphilis of the internal genitalia recorded that is

all infecting the uterus and in one of these cases the disease affected the endometrium. I would like to ask Dr Curtis whether the spirochete was demonstrated in this particular case and if so was it a case of syphilis of the endometrium the myometrium or the parametrium?

DR N. SPROAT HEANEY. I wish to congratulate Dr Curtis upon the very interesting work which he has carried out and for the careful way he has presented his findings. The small number of positive cultures has been a great surprise to me. I would like to ask Dr Curtis if in any of the uteri containing polyps if the polyps showed positive cultures since we ordinarily believe that a polyp is a result of an inflammatory reaction in the endometrium and also ask whether the histological examination of such polyps regularly showed round cells and plasma cells. If the histological and cultural findings in this class of cases are negative we must remove polyps from the classification of inflammatory reaction.

DR CURTIS (closing). In response to the question of Dr Davis in which he speaks of the effect of displacements of the uterus upon the condition of the endometrium I have found that when the uterus is markedly displaced there are more mononuclear cells infiltrated into the tissues. Whether there is a real infection in these cases our methods are not delicate enough to determine.

The point which Menge made was this: the gonococcus possesses the capacity not common to other bacteria of passing the internal os without difficulty. Insofar as I can determine he believes this from purely clinical experience without sufficient bacteriological study to prove his position.

It would seem more logical for us to assume that the gonococcus gets up into the uterus and into the tubes with greatest frequency not because it possesses peculiar properties which allow it to pass the internal os but rather because it is the pathogenic organism we most frequently find in the vagina and cervix. In 20 cases out of 20 it is the only pathogenic organism present in large numbers in the vagina naturally it is the most frequent in the uterus and above. The streptococcus can travel as fast and as hard through the internal os as can the gonococcus but it is not so abundant nor so frequent. Moreover the gonococcus is expelled from the male urethra with considerable force and it may be that it occasionally shoots at once through the internal os as a result of this.

DR HEANEY. What about the acini? I would like to know whether there was any change in the endometrium in the woman who had hæmorrhage.

DR CURTIS. There was nothing to indicate polypoid changes in the endometrium or other microscopic abnormality except inflammation. The question Dr Schochet brings up is rather interesting. I have seen this one case of chronic syphilis of the uterus. Dr Warthin of Ann Arbor in his recent paper before our Society claimed some things about which I was rather skeptical and

I made up my mind to watch carefully for syphilitic uteri. A month or two later I had such a case upon whom I operated thinking there was a fibroid of the uterus. When the abdomen was opened there was found a symmetrical greatly hypertrophic uterus easily three times normal size. There were no fibroids. We made a gross diagnosis of syphilis and thereafter ordered a complement deviation test which gave a 4+ Wassermann. Upon reviewing the history we obtained information not previously available which clinched the diagnosis. Upon examination of this uterus I found syphilitic changes in the muscle and fascia but was unable to obtain spirochete. It so happens that at one time I worked for five months on syphilis of the stomach and so was in a position to make a more satisfactory examination of the tissues than would otherwise have been possible. There was nothing particularly abnormal in the endometrium except a large infiltration of plasma cells.

The treatment which Dr Davis speaks of at the time of dilating the uterus is quite as efficient and possibly more so than the one I suggested. I do not care how you get the iodine into the cervical canal but do think it should be used.

I fully coincide with Dr Ries in regard to the use of the tent. I think it is pernicious. I was so fortunate as to see two cases dilated with tent with subsequent infection. One of these patients developed a pelvic abscess from which we obtained streptococci in large numbers; the other patient had gonorrhœa of the tubes. After putting in a tent an unsuspected infection was stirred up so much that the tubes were later taken out.

I am not in a position to discuss the cyclical changes which occurred because unfortunately so many of these uteri were markedly pathologic. It is my impression that Hirschmann and Adler like most people who originate an idea are too enthusiastic in drawing hard and fast lines between the various stages of the menstrual cycle. Their idea is essentially quite correct. They insist that one should obtain endometrium from the anterior wall of the uterus from the fundus and lower down. I took tissue from any convenient portion of the endometrium which happened to remain.

In reply to the questions of Dr Ries I have been interested in the bacteriology of the tubes in their relationship to the endometrium but have wished to make my report in detail at a later date. Infection is usually present in the tubes when there is infection of the endometrium. The histologic picture of the tubes when there are bacteria found in cultures is a counterpart of the bacteriological-histological study of the endometrium. In the work which I have done polymorphonuclear leukocytes have been found in considerable numbers whenever bacteria have been present in cultures. I am a little skeptical about these results as bacteriological technique improves in many of these cases with nothing more than mononuclear cell exudates we may later be able to isolate bacteria.

CHICAGO SURGICAL SOCIETY

REGULAR MEETING HELD MAY 4 1917 WITH THE PRESIDENT DR WILLIAM M HARSHBARGER
IN THE CHAIR

ASCENDING INFECTION OF THE URINARY TRACT AN EXPERIMENTAL STUDY

DR VERNON C DAVID read a paper entitled
Ascending Infection of the Urinary Tract An
Experimental Study (see p 130)

DISCUSSION

DR DANIEL N EISENDRATH There is one side
to this subject to which I desire to call attention.

Last November when I was in Boston I had a
spirited discussion with Dr Cabot and Dr Crabtree.
They are warm advocates of the theory of hæma-
togenous infection and do not believe there is such
a thing as lymphogenous infection except in rare
instances. Dr David's work shows that if you infect
the bladder directly as he did in a number of cases
you do not get hæmatogenous infection. It is an
ingenious way to carry out his experiments. By lig-
ating the right ureter he had control of and not
having the two ureters infected he could demonstrate
from his blood cultures that there was no hæma-
togenous infection. Cabot claims that in every one of
these cases there is an excretory colon bacillus infec-
tion and at some place there is an elective affinity
in the pelvis of the kidney. This appeals to me to be
a stretch of the imagination and I cannot agree with
him.

The experiments we made were published in full
in the *Journal of Medical Research* for January 1917.
These experiments were carried out by a technique
similar to that described by Dr David. We used
female rabbits at first but finding as Dr David
states that we had such a large proportion of infil-
trations in our control animals we gave up rabbits
and used dogs. We used 21 dogs and out of that
number we obtained positive cultures from the
bladder in 11 and in 4 out of the 27 we obtained
positive cultures from the kidney. We never obtained
a positive blood culture from any of the animals.

Are these experiments of any value because they
show that in the control animals we had a certain
proportion of positive results? Yes they are.
Pathologists agree that you cannot get a perfectly
clean laboratory animal especially a female animal
because almost invariably you will find they have a
low grade of infection if you examine enough con-
trols. The positive pictures we secured are quite
different from those of control animals.

We have enough evidence from our negative con-
trols and positive experiments to show positively
that there is such a thing as an ascending infection
and it is now only a question as to whether it takes
place by way of the lymphatics or urinary stream.
Most of the evidence shows that it occurs by way of
the lymphatics.

Our work seems to differ in one respect. We find
almost invariably lymphocytes and not polymorphs.
Dr Schultz who did this work with me said the
reason for it is that we were fortunate enough to get
a low grade of infection in all our experiments.
When you see some of the slides you will observe at
once that they are not normal animals and we could
not get pictures following the lymphatics as we see
in the pictures that have been presented by Dr
David. We obtained practically the same pictures
of the staphylococcus and bacillus proteus that we
did with the low virulent strains of the colon
bacillus. That explains why we got lymphocytes
and very few polymorphs.

David's work confirms at least 75 per cent of the
work we have done. There is simply a difference of
opinion regarding the lymphocytes and polymorphs
and I believe the reason we did not get more poly-
morphs is because we did not deal with such an
intense infection. It explains why in certain cases
when we get ascending infection we can get the
pyelitis of pregnancy and the pyelitis of children
which explains so many of the things that help
undoubtedly in the treatment of these cases.

DR DAVID (closes). The question of lympho-
cytes and polymorphonuclear leukocytic infil-
tration as a reaction to different grades of violence
of the same organism cannot be disposed of so easily
by a theoretical explanation. In one case that had
lymphocytic infiltration not only a number of cul-
tures from the ureters but cultures from the
ground ureter were made and shown to be sterile.
The ureter wall stained for bacteria was also nega-
tive. There is one objection to the fact that so many
instances of ascending infection instanced by involve-
ment of the urinary lymphatics occur and that is
that very few positive cultures in the upper urinary
tract accompany this lymphoid infiltration. It is a
question in my mind how much of a factor peri-
ureteral lymphatic involvement plays in infections
of the urinary tract when often a number of days
before the beginning of the experiment the cultures
are sterile. Our work points to the fact that the
open lymphatics in the cut ends of the ureter can
be infected and the infection can ascend to the
pelvis of the kidney and in some instances the
infection can extend to the kidney itself. Where
the continuity of the ureter is not interfered with
perireteral infiltration of a polymorphonuclear type
never occurred unless there was free exudate in the
peritoneal cavity or a peritoneal exudate over the
bladder.

DR NELSON N PERCY read a paper entitled
Three Years Experience With the Surgical Treat-
ment of Pernicious Anemia

AMERICAN COLLEGE OF SURGEONS

HOSPITAL STANDARDIZATION

THE questionnaire of the American College of Surgeons prepared at the beginning of hospital standardization is now in possession of the hospitals of the United States and of Canada. The purpose of the questionnaire is to provide information about actual hospital conditions upon which a practical minimum standard may well be determined. That minimum standard will then become a sort of measuring stick for the classification of hospitals. In this connection some fundamental matters are here considered.

First the project of standardization undertaken by the College does not limit itself to surgery although it is natural to assume a primary interest in surgery on the part of the College. The project is broader than surgery. It deals with the whole sum of things which serve the needs of the patient. It is directed therefore not only to surgeons but also to the medical profession and to the public. It is nothing less than a conquest of efficiency in the care of those who are ill, a conquest of discipline of team work of right and of honor. It calls for the co-operation of all who desire to see the conquest won.

But the moment we enter upon such a conquest we find that we can never separate our efforts from the temper of the days in which we live. It happens that in these days we are in the midst of fresh analyses of liberty and of freedom. It happens that since the beginning of the war the worth of medical science has taken new hold upon the public. The right to health has become a

fundamental of our civilization just as is the right to life. Medical service is no longer conceived of as a luxury chiefly for those able to pay for it. It is a common benefit provided by society for all. These facts bear upon hospital standardization for hospital standardization means the standardization and unification of the medical profession; it means the standardization of the right to health. The whole problem is vital to society just as the privileges of liberty are vital to it.

Now what does this mean? It means that no faction, clique, sect or narrow society may rightly presume to standardize hospitals. That work is of universal concern. It means that hospital standardization is the business of the American College of Surgeons, of the American Medical Association, of the American Hospital Association, of the Catholic Hospital Association, of all medical and related societies, of boards of health and of hospital trustees who are the representatives of the public in the matter. It means that all of the folk of all of these groups must unite with seriousness of purpose and clearness of vision as to what they want. It means that in so far as the American College of Surgeons is concerned in its leadership in this field it must be not merely a society of surgeons for surgeons; its object must be to make direct for all things which serve the needs of patients. That is exactly the work which the College has set for itself. That is the conception which holds the Fellows of the College together in bonds of loyalty and in bonds of honest service. A motive of this kind today is known as medi-

cal patriotism On this ground only does the College ask co operation

Emphasis of the breadth of view of the College at this time is of great importance In effect the College says to internists to specialists to laboratory workers to hospital trustees and hospital superintendents as well as to its Fellows

Our work is to keep people well to overcome disease in the swiftest way known to medical science and at as low a cost as most efficient business methods permit This is work which we willingly accepted Having accepted it we must dedicate ourselves to it We must be sober industrious wise and unselfish we must unite in a great aim determine what the work is to do and go to it

PURPOSE OF QUESTIONNAIRE

To turn now to the purpose of the questionnaire If the College is to classify hospitals from the viewpoint of the patient then it must obtain some definite measure of the success of hospitals from the patient's angle It must determine upon a minimum standard of equipment of organization and of professional procedure and with this standard as a gauge proceed to classify hospitals

But what sort of a standard is to be set up? To answer this question is to explain the policy of the Regents of the College which after much thought and counsel they have adopted That policy is this The minimum standard must be high enough to safeguard the interests of the patient and low enough to be at least within the reach of the majority of hospitals whose motives are creditable The limits of such a standard cannot wisely be determined upon until a thorough analysis of hospital conditions such as will be provided through the questionnaire is at hand

Obviously the standard now attained by some great hospitals with large endowment research laboratories and staffs of specialists is out of the reach of many small worthy institutions At the other extreme is the standard of some hospitals both large and small which means in effect that the institutions are merely boarding houses and that they are unworthy of the confidence and support of their respective communities The

College seeks a standard which lies between these extremes It seeks to define what right conditions are for patients in terms of thoroughness of diagnoses with due laboratory facilities of the continuity of the service of competent physicians and surgeons responsible for the treatment of patients of the keeping of accurate case records with follow up of results of cleanliness etc In general failure on the part of the hospital to meet the minimum standard will be due to lack of effort and of organization rather than to lack of financial resources The question naire is the means employed by the College in order that with adequate knowledge of hospital conditions it may define the minimum standard in accordance with the policy just stated

To this policy another point may be added Neither at this time nor at any time can the service of a hospital be reduced to something positive hard and fast Such service is a set of dissolving views which forever change both with the advance of medical science and with the changing aspects of our social relations It is an evolution The plan is to start with a standard within the grasp at least of the majority of hospitals and then later to advance the standard as may seem wise

WHAT FACTS ARE WANTED?

What facts does the College want from hospitals?

In answering this question the College wishes to emphasize that it seeks no information which may be merely interesting rather than directly useful to its purpose The College is not inquisitive It has endeavored to ask only for such facts as hospitals conceiving themselves broadly as public institutions are glad to give to responsible and interested parties

Here follows briefly a review of the questions asked In the matter of organization and control the College wants to know whether or not the hospital is incorporated

Under financial data and accounting the figures are desired for the total earnings from the operation of the hospital and for the total operating expenditures of the hospital ex

clusive of the out patient department in order that comparable figures may be had of the cost per patient per day in hospitals. Such figures are not of the value usually credited to them because of the different social conditions and costs of commodities in various parts of the country. On the other hand they do represent at least partial conclusions as to efficient management which are of value for the consideration of every hospital.

Under capacity and scope the classifications of patients *admissible* to hospitals for treatment or care are asked also the limitations placed upon the admission of patients due to race. The number of patients for the year in free ward beds in part pay beds and in full pay beds is asked.

Under the hospital staff the following questions are included. Is staff open or closed? Have doctors other than staff members the privileges of the wards? Of private rooms? Are physicians and surgeons who divide fees permitted to practice in hospital? Have the trustees or governing authority taken action with regard to practice of secret division of fees in hospital?

The questions with regard to the secret division of fees are significant. The evil of the practice is so widely recognized that any emphasis with regard to it seems unnecessary. The practice is prohibited by law in Kansas Nebraska Iowa Minnesota Wisconsin Ohio Alabama West Virginia Tennessee and Colorado. Certainly no hospital has a right to claim the good will or the support of its community if it harbors the buying and selling of patients in its care. From the beginning the College has stood unalterably against the division of fees. It has pointed out that the evils of the practice are first incompetent medical and surgical service second unnecessary surgical operations and third the lowering of the whole profession into dishonesty. The College includes a secret profit on eye glasses and appliances in the division of fees. In the final standard for Class A the College will ask each hospital to join with it against the practice. How long would any hospital last in an intelligent community which openly stood for fee splitting?

In the matter of clinical laboratories a

complete outline is desired of the field for which the laboratories are adequately equipped. Special emphasis is placed upon the making of autopsy reports. By general consent today the making of such reports is considered one of the strongest influences to put an end to unnecessary operations. In this connection the College asks the following questions. Number of deaths in hospital in last year? Number of autopsies made during same period? Are complete autopsy reports filed with the respective case records? Whose duty is it to obtain consent for autopsies? Does the pathologist meet with the staff to review the clinical history in relation to autopsy findings? What arguments are used to obtain consent for autopsies?

The College desires to know the extent to which case records are kept in each hospital and the extent to which these records are followed up. A significant question here is: Are patients told before leaving hospital that their subsequent medical history will be asked for? Also these questions are asked. Do the case records as kept by the hospital include a record of the personal history of the patient relevant to the complaint the diagnosis on which the treatment was based the laboratory findings the operation or treatment the post operative diagnosis the complications of convalescence?

When it comes to the clinical departments these questions are significant. Are clean and septic operations conducted in same operating room? Are diagnoses of surgical patients posted in operating room in advance of operation? Are findings at operation recorded immediately after operation?

Nearly two pages of questions relate to the opportunities afforded to interns. By these questions the College seeks definitely to know whether or not the hospital offers reasonable facilities for the training of interns. The information sought here will be alike helpful to hospitals and to recent medical graduates who seek internships.

THE BUSINESS OF THE COLLEGE IN STANDARDIZATION

Although the facts are well known to the Fellows of the College some word here may

be of interest as to why the College entered the field of hospital standardization

Thus briefly is the reason. The College is a responsible society of about 4 000 surgeons. It aims to include in its Fellowship all who possess practical scientific knowledge of medicine and surgery together with honor, trustworthiness and strong moral character. To determine upon the fitness of candidates for Fellowship is a grave problem which involves an estimate of the candidate's training in the medical school and in the hospital as intern and assistant. The problem is further complicated by the fact that among hospitals there is wide discrepancy in the educational opportunities offered there is

confusion as to the value of all phases of these opportunities even among hospitals of like or comparable equipment.

The Regents of the College must therefore answer two questions. First, what are the actual standards in the practice of medicine and surgery among hospitals? Second, what is an acceptable standard in the practice of medicine and surgery among hospitals? The second question involves the larger question as to whether the standards among our best hospitals are too good for the humblest patients anywhere on this continent? The Regents therefore take up hospital standardization as an obligation of their trust.

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THE TREATMENT OF FRACTURES OF THE EXTREMITIES BY MEANS OF SUSPENSION AND TRACTION

By MAJOR JOSEPH A. BLAISE, M. R. C. AND LIEUTENANT KENNETH BULKLEY, M. R. C.

IN 1916 one of us¹ described a method of treatment for fractures of the extremities by means of suspension and traction and reported 103 fractures treated in this way. Since the publication of that paper there have been so many additions and changes that it has seemed wise not only again to describe the method but also to give the broader principles of application and a somewhat detailed description of its use for various fractures of the extremities at different levels.

It is the object of this paper to describe in detail (1) the various parts of the apparatus and (2) the method by which each fracture according to site is treated.

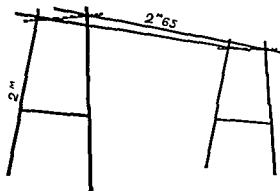
The advantages of the method previously described need be but briefly reviewed. The improvement in the circulation of the limb as evidenced by the rapid diminution in swelling, the greater ease of dressing the facility with which the fracture can be controlled and the great comfort of the patient all speak in its favor. It is our distinct impression that union takes place more rapidly, that spreading infection necessitating amputation takes place less frequently and that the motion of contiguous joints is more free than by the use of any method of treatment involving absolute fixation.

Unlike the simple fractures seen in civil

practice in which the mechanism of fracture and the lines of force are fairly constant and the resulting displacement therefore also relatively constant the compound fractures of military surgery follow no regular displacement. This is due to the fact that the great majority of compound fractures by shell are the most common and important type seen are associated either with more or less extensive loss of muscle tissue or attachment or with nerve injury resulting in paralytic muscle. The relative position of the two fragments is therefore inconstant and it is invariably necessary to place the limb in such a position and maintain it there *or change it if necessary* so that the lower fragment is brought into correct alignment with the upper. We believe that this can best be accomplished and the concurrent wound at the same time be best treated by combined suspension and traction. By this method carefully controlled by bedside roentgenographs the proper alignment can be maintained.

THE APPARATUS

The apparatus for suspension consists of two frames each fitted to an end of the bed and connected above the bed by two or more parallel bars. Each frame consists of two uprights joined by two transverse bars, the lower placed at the upper level of the mattress and the upper just low enough so that the



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uprights are not split by the holding screws. The upper transverse bar is notched to hold the longitudinal bar. Each upper transverse bar having nine such notches. Each longitudinal bar has two notches at a distance from each other corresponding to the distance between the two end frames. The interlocking of the angles prevents slipping and gives solidity. Figure 1 illustrates the construction of the frame.

The end frames (Fig. 2) have the form of a truncated cone, but downward the distance between the feet being a little more and the distance between the upper end being a little less than the width of the bed. The width therefore is an inconstant factor depending on the bed used. The height is generally two meters. With pine, which has proved to be a very satisfactory wood, we have found that pieces 3 centimeters wide and 1 millimeter thick are sufficiently strong for the vertical and lower transverse bars, and pieces 6 centimeters wide for the upper transverse and longitudinal bars.

In order to allow the patient to change his longitudinal position, as for instance to sit up in bed, suspension must be movable. This is true only for fractures of the lower extremity. For those of the upper extremity it has seemed unnecessary. This range of motion is accomplished by the use of a trolley (Fig. 3) consisting of a track and a movable piece of wood suspended from it. The track

consists of a bar of iron, 10 millimeters thick and about 90 centimeters long, right angled at one end. The straight end passes through a hole in a small piece of iron bent to a right angle and screwed to one of the longitudinal bars. The angled end of the track is fastened to the bar by a bandage. Suspended from this is a block of wood about 40 centimeters long in the upper edge of which are screwed two pulleys to run on the track, and on the lower edge of which are screwed three pulleys for suspension. Pulleys attached either by screws or hooks may be used. The latter seem more readily adjustable. The weights are commonly of 500 grams each. For more delicate adjustment and especially where they are to be used suspended over the bed, small shot balls varying in weight from 250 to 1000 grams are employed. The approximate weights used are shown in the diagrams, but it must be remembered that they should be so adjusted as exactly to counterbalance the weight of

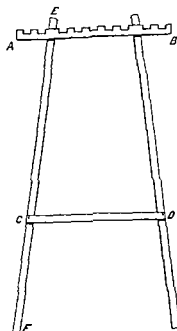


Fig. 2. The track is a bar of iron, 10 millimeters thick and about 90 centimeters long, right angled at one end. The straight end passes through a hole in a small piece of iron bent to a right angle and screwed to one of the longitudinal bars. The angled end of the track is fastened to the bar by a bandage. Suspended from this is a block of wood about 40 centimeters long in the upper edge of which are screwed two pulleys to run on the track, and on the lower edge of which are screwed three pulleys for suspension. Pulleys attached either by screws or hooks may be used. The latter seem more readily adjustable. The weights are commonly of 500 grams each. For more delicate adjustment and especially where they are to be used suspended over the bed, small shot balls varying in weight from 250 to 1000 grams are employed. The approximate weights used are shown in the diagrams, but it must be remembered that they should be so adjusted as exactly to counterbalance the weight of

the limb. Due to the decrease of oedema they frequently have to be reduced after the first or second day.

The limbs are suspended either by cloth bands or by metal splints to which cords are attached. The different forms will be described with the different fractures in which they are used.

For adhesive material we have used two different glues: (1) Heussner's glue (Colophane 50, 90 per cent alcohol 50, Venetian turpentine 1, benzine 10) was formerly used in all cases and proved exceedingly satisfactory except for the occasional blistering which took place under it and for the necessity of shaving the part before application. After being applied to the shaved skin with a brush, the special extension bands of canton flannel (Fig. 4) are laid on the extremity and bridged in place. These bands are made in advance in two sizes: one for the leg and the other for the arm and sole of foot and are provided at one end with a tape to

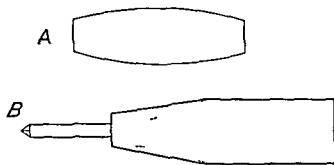


Fig. 4 shows the shape of the band used to support the limb in a Hodges or Blake splint or in a forearm cradle. They are made of 2 layers of unbleached muslin and in two sizes. The smaller measure 40 by 2 centimeters and the larger 60 by 2 centimeters. With wet dressings bands of similar sizes but made of double-faced rubbered linen can be used.

Fig. 5 shows the bands used with glue for traction. They are made of canton flannel in a small size for the forearm and the sole of the foot and a large size for the leg. They measure without the tape 25 by 8 centimeters and 40 by 5 centimeters respectively.

fit the buckles of the apparatus. In using Heussner's glue the skin should be prepared with soap and alcohol but no antiseptic should be used. Absolute cleanliness and the removal of all grease is essential. More recently we have been employing the glue of Sinclair Smith (common glue 50, water 50, glycerine 1, thymol 1, calcium chloride 1). Its chief advantages are that the part does not require shaving before application and that it can be removed by the application of hot moist towels. It should be painted on the skin hot in a direction opposite to that in which traction is to be made. This avoids the discomfort of pulling hairs. Blistering seems to take place a little less frequently with this watery glue than with the varnish glue of Heussner possibly due to the greater ease of evaporation. With either glue the bands will usually hold for ten days to three weeks before renewal becomes necessary.

This action can usually be applied about twenty minutes after the bands have been glued in place. The details of the methods employed for fractures at various levels must be carefully studied for each individual case as the lines of fracture and the injuries to soft parts with the resulting displacement of fragments vary so greatly. Constant supervision and revision of position and

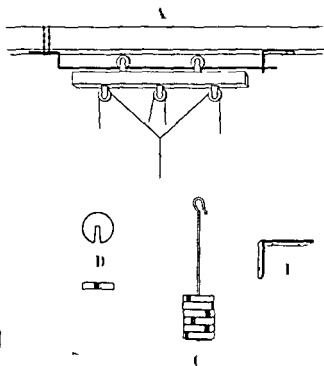
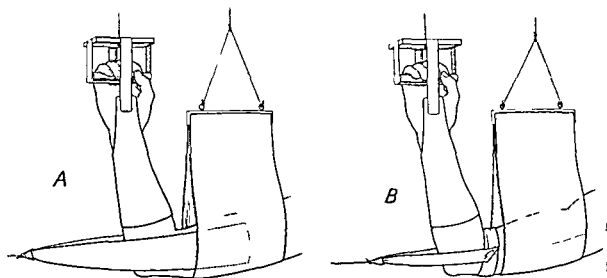


Fig. 3. To the arrangement of the traction. In 1 can be attached the cord for traction and right angle at one end while the other end is attached through a small piece of cotton (C) and a lead weight (D) is attached to the cord. The cord is pulled by a cord and three belt hangers from this (A and B) the lead weights used each eight or ten pounds.



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 f t h m l l t t t t l l b p l f t v p l l g t b d l l t l p e t

weights necessary for only in this way can the best results be obtained. It is essential that each apparatus be duly examined and the alignment of fragments clinically noted. If the slightest doubt as to position occurs a bedside fluoroscopic examination or roentgenograph should be made. As far as possible we will attempt to indicate the treatment necessary for fracture of the extremities at various levels.

HUMERUS — GENERAL CONSIDERATIONS

The general arrangement of suspension and extension for fracture of the humerus is shown in Figures 5, 6, 7 and 8. Suspension is made at two points: direct suspension of the humerus itself and suspension of the forearm. The humerus is suspended by a single band of double-faced rubberized linen 20 centimeters wide and 70 centimeters long. The double bands originally described have now been practically discarded as unnecessary. The angulation they were designed to correct can be more easily controlled by traction if used and by the amount of suspension applied to the forearm. The single band passes

under the arm and is attached at one end by thumb tacks to a block of wood. Its other end is pierced by eyelets which accurately fit small nails on the opposite side of the same block. In this way the band is not only prevented from becoming wrinkled but it can be readily removed for dressings. To each end of this block is attached the extremity of a cord about 50 centimeters long, from the center of which is carried a second cord leading vertically upward from the center of the humerus to a pulley in a longitudinal bar. The relative amount of suspension obtained at the proximal and distal ends of the band can be controlled by shifting the point of attachment of the vertical cord to the cord attached to the block and anchoring this point of attachment with adhesive. In general a kilo and a half suffices for the direct suspension of the humerus.

The forearm is suspended by means of two bands glued on the flexor and extensor surfaces (Fig. 8). They should not meet on the lateral aspects of the arm because of the constriction and interference with circulation which might follow. The tapes which are

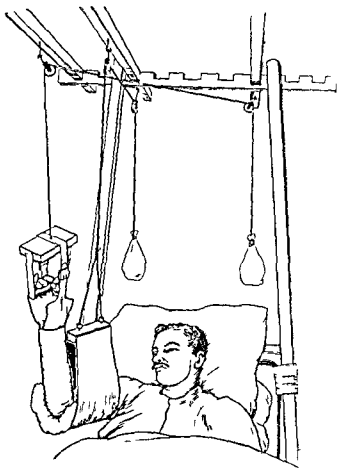


Fig 6 To illustrate the method of suspension in fracture of the humerus. It is to be noted that three longitudinal bars are employed the outermost serving to support the forearm and maintain out-ward rotation of the lower fragment (see under Humerus general considerations).

fastened to the ends of these bands are attached by buckles to a wooden spreader at the center of which is a hole for a knotted cord for suspension. The spreader for the hand should be a little longer than the width of the fist and three quarters as wide as its length. The straps of the suspension band pass over the side of the spreader while to the ends of the spreader are fixed two elastic tapes attached to a round handle which can be adjusted so that the fingers can readily grasp it for exercise. This arrangement is of importance especially in lesions of the musculospiral nerve. The suspension cord passes to a pulley on a longitudinal bar above the bed this bar being placed 30 or more centimeters to the outer side of the bar by which the humerus is suspended (Fig. 6). In this way external rotation of the lower

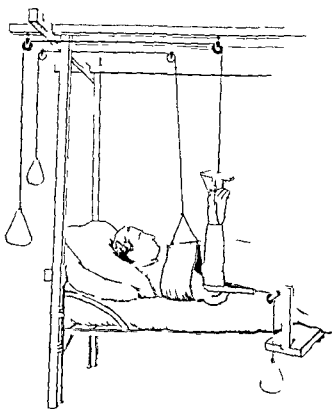
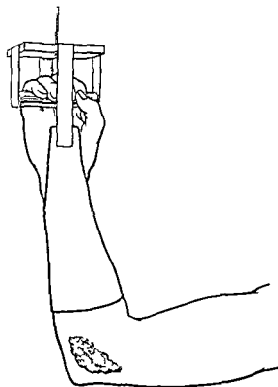


Fig 7 To illustrate a simple method of obtaining abduction and traction by means of a rough board slipped between mattress and bed frame and holding by friction (see under Humerus upper third).

fragment is obtained a result difficult to get if both humerus and forearm are suspended in the same longitudinal axis. The pulley suspending the forearm is usually placed sufficiently toward the foot of the bed to keep the elbow at an angle of about 135° . Later the angle may be decreased to 90° but the larger angle if used early assists in traction.

If traction is necessary it can be obtained in one of two ways. Traction on the lower fragment by means of glued bands (Fig. 5) on each lateral aspect is very efficient. The spreader for traction of the arm should exceed the width of the elbow by 5 centimeters to avoid pressure on the humeral epicondyles. Traction is made from the spreader by means of a cord which passes over a pulley in a transverse bar attached at a suitable height to the frame at the foot of the bed. If the wound in the arm is in such a position that glued bands cannot be applied traction can be obtained by means of a band passed about the lower humerus in much the same way as



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in the method of Hennegou in fractures of the femur. This band is made of heavy muslin about 6 centimeter in width and 1 meter in length. It is centered placed on the posterior surface of the lower arm each end being brought forward and crossing to the opposite side where it is pinned in such a way that the traction when applied will be in the same axis as that of the humeral shaft (Fig. 5). In low wounds of the arm a thick layer of cotton should be placed between the dressing and the band. Countertraction by the weight of the body is sufficient for fractures of the humerus.

In all fractures of the humerus treated by this method the patient should be encouraged to move the shoulder elbow wrist and fingers and the hand and fingers should receive daily massage. The question of the amount of abduction will be considered with the detailed treatment of the fractures at different levels.

We will consider the modifications of the above outlined treatment as they apply to fractures at various levels of the humerus under three heads: (1) fractures of the upper third including resections of the humeral head; (2) fractures of the middle third; and (3) fracture of the lower third including resections of the elbow.

Humeral upper third including resections of the humeral head. Cases falling in this group should all be suspended as above outlined. Following humeral head resections traction should not be used. The deltoid should not be stretched but rather allowed to crowd the divided shaft as closely as possible into the glenoid. Loss of function of the circumflex nerve or extensive loss of substance of the deltoid means a poor end result following resection. The arm should be abducted nearly to a right angle in order that the position after healing can be assumed by the patient. Adduction can always be obtained by rotation of the scapula.

In high fractures of the surgical neck the upper fragment is usually abducted and strongly rotated outward. The lower fragment must therefore be brought into this position. Figure 9 shows the arrangement of a patient with such a fracture. It will be noted that the frame at the head of the bed has been somewhat modified to meet the unusual requirements. The amount of traction in such a case must depend on the bedside roentgenographic findings.

In the fractures of the upper third of the shaft below the surgical neck traction is usually necessary but need seldom amount to more than 2 kilos. It can usually be applied by means of glued bands. Suspension is carried out in the usual manner. The amount of abduction necessary will depend entirely on the amount of muscle injury. If the pectoral and latissimus attachments are lost the abduction requirement will be greater than if these muscles were intact. Generally speaking, the fractures require about 60° abduction. A very simple method of obtaining this is shown in Figure 7. It consists in a rough unplanned board about 50 centimeters longer than the width of the bed and about 5 centimeters in width. This is

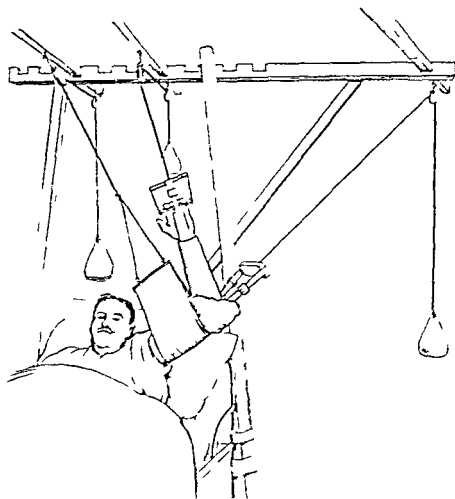


FIG. 1. Fracture of the humerus. The arm is held in a position of abduction and flexion. The weight is attached to the end of the cord. The patient is lying in bed.

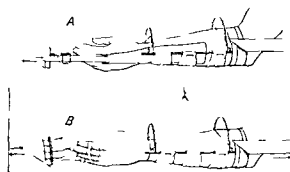
placed between the mattress and bed spring and is held in whatever position desired by friction and the weight of the patient. To its free end is attached an upright carrying a pulley. It can be placed in any position desired. It is essential that this board be rough and unpainted.

Humerus middle third. Fractures of the middle third are suspended in the usual fashion but require careful attention to prevent interposition bowing. Fracture is usually made at an angle of abduction of about 45° and with a weight of about one and a half kilo. The concurrent wound is usually such that a Hennequin band must be used and it is in this group of fracture more than any other that the band must be pinned close to pull exactly in the axis of the humeral shaft (Fig. 3, 1 B). If the band is not pinned

sufficiently low, anterior angulation will occur and if pinned too far posteriorly, backward angulation takes place. The angulation is also controlled by the relative amount of weight used to support the forearm and the arm. Too much weight attached to the forearm results in posterior angulation while too little allows sagging of the elbow with resulting anterior angulation.

Humerus lower third including resections of the elbow. The higher fractures of the lower third are treated exactly as are those of the middle third. Care must be taken that the band supporting the humerus extends well below the site of fracture; otherwise the elbow will sag and anterior angulation occur. Abduction need rarely exceed 30°. Traction of one kilo is usually sufficient.

After resection of the elbow, traction



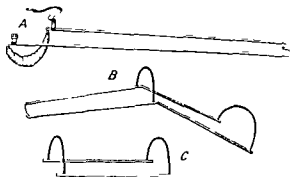
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should never be used. The functional result obtained will depend largely on the operative procedure. If a careful subperiosteal resection practiced by the Iken School is done early motion of the elbow will be encouraged with the view to reformation of the joint. If the periosteum has not been preserved the best that can be looked for is ankylosis but a flail joint will more often be the result. Suspension for the second type of case is useful only until the absence of the infection in the wound and should be replaced by absolute immobilization of the elbow in plaster as soon as possible. If ankylosis can be obtained the angle of choice depends on the occupation of the patient. In a laboring man or farmer about 135 gives the most useful arm.

In compound fractures of the elbow joint without resection and in suppurative arthritis of the elbow joint suspension is most valuable but should be made only by the forearm (Fig. 8). The weight of the upper arm then tends to keep the end of the bone separated and thus facilitate drainage.

FOREARM

The usual method of suspension and extension of the forearm is shown in Figure 10. The forearm is suspended in a sort of cradle (Fig. 11 c) which consists of two round iron bars each 40 centimeter long and 8 or 9 millimeters thick held together by lighter



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curved iron bars riveted by their ends in holes in the parallel bar. The parallel bars are 15 centimeters distant from each other but this distance can be increased by reducing the arcs. The arcs pass above the forearm which is supported by double linen bands sewed to one another (Fig. 4 f). The narrow ends of the bands are passed over the sides of the parallel bar and fastened either with safety pins or metal clip in such a way that they can be readily adjusted to support the part. When wet dressing or continuous irrigations are used similar band of double facial rubberized linen can be employed. If the wound permit extension can be made by band glued to the lower forearm. In lower wound very slight traction can be obtained by means of a glove shown in Figure 10. The hand is thoroughly covered with glue and then a white cotton glove to the end of each finger of which has been attached a small metal ring is drawn on. Traction is then made through the fingers a much as a kilob and a half weight being used. Great care must be taken that at least twice each day the traction is removed and both active and passive motion of all the mill joint of the finger practiced. Full supination is seldom necessary a point a little short of this usually sufficing to prevent cross union.

In cases with considerable adema it is

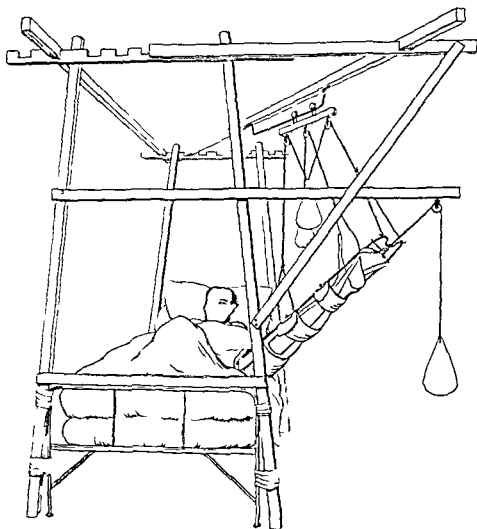


FIG. 11. To show the use of the straight splint and the method of obtaining traction. Note especially the build-out of the foot of the frame, the wide abduction obtained, the angle of the supporting longitudinal bar, also its corresponding to the angle of abduction of the leg, and the turnbuckle method of obtaining traction within the splint. The method of preventing foot drop is also shown.

occasionally useful to suspend the forearm either with band or a glove in the vertical position. As soon as the condition of the wounds permits the majority of fracture of the forearm especially if one bone alone is involved can be treated in molded plaster as suspension offers no particular advantage.

FFMUP — CLINICAL CONSIDERATIONS

In the treatment of compound fractures of the femur the ideal can frequently not be obtained by any apparatus but with suspension and traction the results are more satisfactory than by absolute immobilization. The ideal position of flexion at the knee and hip thus giving muscular relaxation is often

prevented by the fact that the position of the wounds interferes with the application of the traction. However in the majority of cases satisfactory alignment with little or no overriding can be obtained and the freedom of motion of the patient in bed prevents to a large extent the onset of pulmonary complications, probably the most common late cause of death following this type of injury.

All fractures of the femur at whatever level are suspended. Figure 11 *A* and *B* show the two types of splint employed. The application of each will be described under the separate fractures. The upper straight splint is a recent modification by Lieutenant Colonel W. I. Keller United States Army of the splint

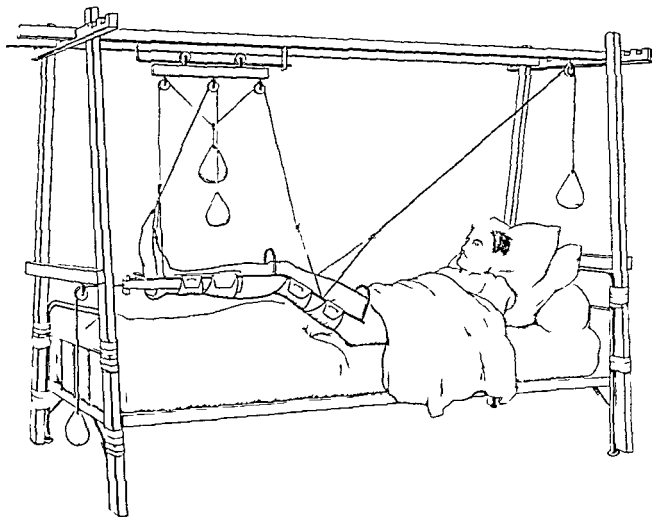


FIG. 4. Illustration of the method of suspension of the lower leg. The plantar band is attached to the middle of the sole of the foot. The plantar band is attached to the middle of the sole of the foot. The middle of the sole of the foot is attached to the plantar band. The plantar band is attached to the middle of the sole of the foot.

With skeletal traction especially with a Steinman pin through the femur about one third of this weight is necessary. It is the ideal form of traction provided the question of infection can be eliminated. It is especially applicable in fractures of the upper half of the femur in connection with a well bent Hodgen's splint.

In the third method of applying traction the knee is flexed and the tractive force is applied against the back of the calf. This is ordinarily accomplished in one of two ways. In Hennequin's method the limb is high as the mid thigh is surrounded by a very thick dressing of non absorbent cotton snugly bandaged in place. The knee must be kept in flexion while the dressing is applied and it is well to put a wet crinolin or very thin

plaster of Paris bandage over all to keep the dressing in place. A figure of 8 litch is then made about the thigh and knee by means of a sheet folded several times so as to make a band a meter and a half long and 15 centimeters wide. This is probably the best method when the Steinman pin cannot be used for high fractures of the femur. It obviously can not be used in case with low wounds of the thigh. The other method of calf traction is to bandage the leg to a well bent Hodgen's splint and make the traction on the latter. This method affords access for dressing to wound in the lower part of the thigh but is scarcely applicable for initial traction because the pain and pressure on the calf are too great. Later when less traction is needed it becomes a very serviceable method.

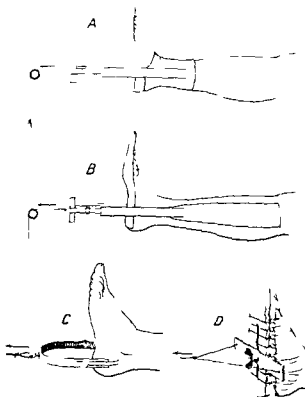


Fig. 12. The arrangement of the traction band for a fractured femur. A, side view of the leg; B, top view of the leg; C, side view of the foot; D, top view of the foot.

The arrangement which we use for preventing foot drop in all the cases of fractured femur and in some cases of fracture of the lower leg, depending on the form of traction used, deserves a word of explanation. A cotton flannel traction band as used for the arm (see Fig. 4) is glued to the sole of the foot and extends a short distance beyond the toes. This band is attached to a cord which runs in a pulley attached to the trolley above the bed and has attached to it about a half kilo of weight. This maintains the length of the tendo Achillis and at the same time gives a movable support against which the patient can exercise the ankle. Rotation of the lower fragment can to a certain extent be controlled by changing the angle at which this band is fixed to the sole of the foot (Figs 12, 14 and 15).

Femur upper third. In fractures of this

portion of the femur the abductor and external rotator group of muscles are seldom destroyed and almost never lose their nerve supply. They accordingly continue to functionate with resulting wide abduction and external rotation and some flexion of the upper fragment. For fractures at this level the Hodgen's splint shown in Fig. 11 B is generally used. Wide abduction together with noticeable elevation and external rotation is the position of choice, the elevation helping to maintain countertraction by the weight of the patient's body. If there is a tendency for the patient to be pulled downward additional countertraction can be obtained by moderate elevation of the foot of the bed. The amount of traction needed depends to a certain extent on the loss of bony and soft tissue on the musculature of the patient and on the length of time after injury when it is started. As a general rule it is advisable to make strong traction during the first week as greater lengthening with less weight can be obtained then than later. Ten kilos is usually sufficient, but the amount of weight used must be carefully controlled by accurate measurement and roentgenography.

Internal rotation of the lower fragment is obtained by elevating slightly by means of the suspension cords the inner side of the splint and by applying the band glued to the sole of the foot diagonally from the outer side of the heel well to the inner side of the great toe.

Figure 13 shows a patient with such a fracture. It will be noted that the frame at the foot of the bed has been modified by the addition of a longer transverse bar allowing abduction. In this case a Steinman pin has been used. If the situation of the wound is such that the use of a pin appears dangerous because of possible infection, excellent traction can be obtained by the method of Henneguin using a wide and well flexed Hodgen's splint (see *Femur general considerations*). If for any reason either a Steinman nail or the Henneguin method cannot be used the limb is put on a tractioned Hodgen's splint traction being made by a band glued well above the knee with wide

abduction external rotation and flexion at the hip. Or a Pinocchio stirrup can be employed. At least 12 kilos traction will be needed in order to stretch the hamstring and overcome the weight of the limb.

Femur middle third In these the wounds are in the middle of the thigh and do not interfere materially with the use of any splint. But the method of Henequin cannot be well employed. The position assumed by the upper fragment is in abduction if the fracture is above the adductor longus insertion; otherwise it is nearly straight. It is moderately flexed and rotated out.

The method of treatment depends on whether a Steinman pin can be used or not. If it can be used the limb is put in a well flexed Hodgen's splint with the knee and hip flexed and is suspended in a position of moderate abduction and rotation outward. A traction weight of 4 to 5 kilos is to be used at the outset.

If the Steinman pin cannot be used on account of infection extension straps or the stirrup are used with a straight Hodgen's or modified Thomas splint (the latter gives better lateral control of the fragments) and the limb suspended in a position of a slight abduction and flexion at the hip with rotation outward. A traction weight of 10 to 12 kilos is used at the outset.

Femur lower third These fractures are very difficult to treat on account of the position of the wound which often prevents the application of the proper method.

The position assumed by the upper fragment is practically in line with the body; the tendency to flexion being overcome by the sheath of the surrounding muscles. It rotates outward about 30°. The lower fragment however flexes at the knee and in order to get it in line with the upper fragment the knee must be flexed. The only efficient way in which to apply traction with this position of the knee is by means of the Steinman pin and this should be used in all clean cases. Treatment then is simple and the leg is put up as described for fractures of the middle of the shaft with a weight of 3 to 4 kilos.

But in the majority of cases the Steinman pin cannot be used on account of infection

and then one is forced to use treatment bad in principle namely to put the limb up in a straight splint with extension straps or the stirrup for traction and wait until union is just beginning but the fracture line is still soft and pliable. The straight splint is then removed and a Hodgen's splint angulated to about 110° put on. When the limb is bent on this splint flexion will not take place at the knee which will have become stiffened but at the fracture and the fragments will be brought into line. To be successful strong traction must be made up to the time of changing the splints so that the muscles are actually overstretched and all overlapping overcome.

Fractures of the tibia and fibula All wounds and fractures of the leg repair far more quickly if the limb is suspended and this should always be done. The Hodgen's splint bent to an angle of 135° is employed the usual arrangement being shown in Figure 14. The leg is suspended in the splint by the usual bands and the splint suspended above the bed by the trolley previously described. Countertraction is obtained by the portion of the splint supporting the thigh care being taken that the upper suspension cord passes to the longitudinal bar on the opposite side of the bed.

Fractures of the tibia alone are of little consequence being well supported by the tibia. They are suspended because of the improvement in circulation and for the dressing of wounds but no traction is necessary.

Fractures of the tibia alone are splinted by the fibula and are prevented from overriding to any great extent but incurvation is common. A slight traction of one to two kilos will correct this tendency.

Fractures of both bones demand more care. Here traction of three to four kilos is necessary.

Figure 15 illustrates the four methods of traction which have proved most satisfactory. They are more or less interchangeable but each has its advantages.

Figure 15 A illustrates traction by a gutter made of two layers of unbleached muslin having grooves the instep and provided at each

SUTURELESS SKIN-SLIDING METHOD FOR THE RADICAL TREATMENT OF LUNG ABSCESS AND CHRONIC OSTEOMYELITIS

SPECIALLY ADAPTED TO WAR WOUNDS¹

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S. G. T. H. N. H. C. B. G. H. P. I.

THE present war has produced a tremendous increase in the number of chronic suppurations. The hospitals of Europe are overcrowded with just such cases and no doubt before long we too will have thousands of these chronic suppurative cases to treat. It is therefore imperative and timely to discuss the treatment of chronic suppurations of bones and joints and the chest cavity.

I desire to bring before the profession some new suggestions for the treatment of this protracted type of suppuration. These suggestions are based on an experience gained in treating several thousand cases of chronic suppuration. Although most of the cases treated were not due to injury but originated from infectious diseases, the late conditions in both instances are so similar that I believe the treatment here outlined will be just as effective in war injuries.

Nearly all of the war wounds are infected from the very moment the missile penetrates the tissues. Infection is carried into the wound by fragments of clothing or the trench dirt which usually covers the soldier's skin. It is fortunate that the field surgeons are now in a position to disinfect most of the wounds before the infection has spread and thus prevent many deaths or the loathsome chronic pus discharge.

The methods of this immediate sterilization of wounds such as were introduced by Carré and others and likewise the total excision of the infected wounds as practiced by English surgeons need only be mentioned here since my remarks will be confined to the treatment of the late case, those in which the prophylactic method had already been employed but in spite of which the chronic suppuration had persisted.

Guillot and Wormant who recently published their experiences with infected frac-

tures in the French base hospitals state that probably 50 per cent of all fractures of the thigh still suppurate after ten months treatment. Can any one of us realize what an amount of suffering this causes and what expense and labor is involved in dressing these wounds aside from the economic loss caused by the incapacity of this vast number of men?

We shall divide the subject into two parts:

1. The treatment of chronic empyema and lung abscess after prolonged suppuration.

The treatment of chronic suppuration resulting from bone infection.

There is a vast amount of literature on both of these subjects. The evolution of methods of treatment varying from decade to decade is well known to surgeons but the fact that thousands of cases remain uncured indicates that we have not yet perfected our methods. We still encounter chronic suppurative empyema and lung abscesses as well as sinuses from bones and joints which have persisted for a quarter of a century although they may have been operated upon repeatedly by most competent surgeons.

CHRONIC SUPPURATION OF THE LUNGS AND EMPYEMA

In order to arrive at a rational and consistent treatment we must first ascertain in each case the etiology and pathology. The majority result from infectious disease of the lung or pleura pneumonia and tuberculosis being the most common. Other diseases furnish a minor percentage. Injury to the lung caused by stab or gunshot wound or crushing in peacetime produces only a small percentage of cases but now in war times the traumatic type predominates.

A foreign body penetrating the chest nearly always carries with it some infectious material and this produces a suppuration.

J. P. Simonds, who has made an extensive study of the gas bacillus infection, stated that the pores of the bacillus welchii were found in 100 per cent of the uniforms of Belgian soldiers who had come directly from the trenches and also in the meshes of the samples of the new cloth from which the uniforms were made. Of twenty fresh war wounds fifteen were found to contain this group of bacteria.

Even if the wound is sterile the injury to the lung and the accumulation of blood furnishes a very favorable pabulum for subsequent infection and a consequent pyothorax.

At times a foreign body will remain in the lung for years without causing any symptoms and then give rise to the most distressing condition—a lung abscess. The repeated puncture for a serous effusion may change the sterile fluid into pus and thus produce an empyema.

The diagnosis of empyema is a rather simple matter. It must be differentiated principally from a serous effusion and from a lung abscess. A dullness of the chest which changes with the position of the patient corroborated by stereoroentgenogram establishes the presence of fluid with unmistakable certainty. All that remains to be ascertained is whether the fluid is blood, pus or serum. A puncture will decide the question.

Quite different and difficult is the diagnosis of lung abscess. A patient may be ill for weeks or months carrying an abscess in his lung without its detection by the most painstaking search of the ablest diagnosticians. Even repeated puncture may fail to reveal its presence.

The cause of this difficulty is apparent when we consider that a lung abscess is usually much smaller in size than an empyema, is more centrally located and is often surrounded by healthy lung tissue or associated with a pneumothorax.

I regard a stereoroentgenogram of the entire chest as the most helpful aid in the diagnosis of lung abscess. We rely upon this one aid more than upon all the other diagnostic means except the history of the case. The stereo cope separates the different structures in the chest. The overlapping shadows which in the single

plate produce an indistinct and blurred picture stand out in plastic effect so that the lung abscess may be detected.

When a lung abscess has once ruptured into a bronchus the diagnosis is as a rule mighty easy. In fact we cannot escape it. It forces itself on one with the expiration of the patient's first breath when he begins to relate his complaint. Not all lung abscesses however have this characteristic foul odor. Some have no odor at all but the patient will give the history of rupture of the abscess. He will relate how all at once he spat up a cupful of matter. Such cases however offer great difficulty in the localization because the abscess is collapsed and never fills sufficiently to give a distinct shadow in the roentgenogram or a sufficiently large area of dullness which can be outlined by percussion.

The diagnosis is certain if the surgeon must decide what form of treatment to use. The accepted procedure are so well known that I shall not discuss them in this paper except to make a few suggestions which may be helpful in preventing the formation of persistent drainage.

The empyema should be drained as low as possible and preferably posteriorly. Many cases persist in this draining because the tube has been inserted too high and a recess formed by the dome of the diaphragm and the chest wall allows the retention of quantities of pus. When the drainage is low the suppuration will usually cease within three or four weeks or occasionally it will persist for three or four months. A small residue about one case in twenty will keep on draining indefinitely especially a lung abscess which communicates with one or more bronchi. I have in my records of 110 consecutive cases of this last mentioned type of empyema and lung abscess a case in which the sinus resulting from drainage persisted for thirty years.

When there is no tendency to spontaneous closure the problem becomes a very difficult one. The patient usually resigns himself to his misfortune, dresses his chest wound once or twice a day and is well enough to perform some light work. Whenever his health suffers he becomes discouraged and is willing to take great risk, he will submit to any opera-



Lat I B m th p t j t d t l b
t g t b



It te II L d g b
t d t h m l t p g
d k fl p b e g h l d



Lat III Sh g ca t zat n f th m
f th b h by m fl y t y l g



Plate VI Further dissection. Implantation of kin flap into pleural cavity. Pleural cavity not removed.



Plate V Final result. Complete obliteration of abscess and opening into bronchus. Only short funnel lined.



Plate IV Implantation of kin flap into depth of the abscess cavity. Kept in place by gauze packing.

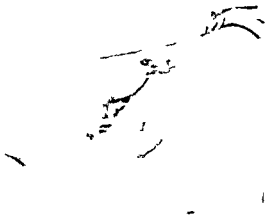


Plate VIII Illustrates the condition two weeks after the operation shown in the denuded surface of the thigh



Plate VII Shows and describes the technique of the implantation of a flap into the part of the cavity

Plate IX Three months later after complete healing



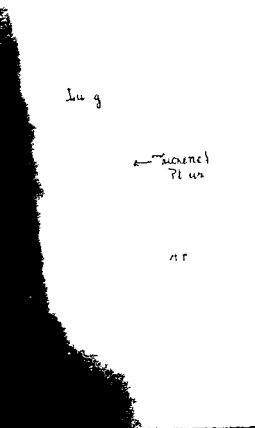


Fig. 1. Empyema showing the thickened pleural lining of the cavity to the left of the compressed lung to the right of the empyema cavity.



Fig. 2. Empyema (shown in Fig. 1) injected with bismuth paste. Note the thick pleura on the margin of the cavity.

in which will either cure him or commit him to his grave.

Ten years ago we introduced into surgery a new method of dealing with this class of cases, namely, the injection of bismuth paste. It is unnecessary here to repeat in detail the advantages and technique of this method. At this time the bismuth method is well known and the results from its employment and its dangers are all well defined. Let it be said that after ten years of trial in almost all parts of the world, it has retained its place and is employed more extensively now than

ever. The reports in the literature indicate that at least 4 out of 5 cases of the very old neglected suppurative empyemata or lung abscesses may be cured by this simple procedure. Ochsner of Chicago reported to the American Surgical Association on June 4, 1909, 14 cases of empyema, all of which had been operated on (two by Islander operation) with failure in all cases, permitting nevertheless. He applied the bismuth paste in each of these cases with the result that 11 cases healed completely and 3 are still under treatment at the time and very much im-



Fig 6



Fig 7



Fig 8

Fig 6 Outlining the flap incision for empyema
Fig 7 Skin flap implant into empyema 8 weeks after operation showing width of denuded surface

Fig 8 Patient 8 weeks after operation showing denuded surface cured with kelp powder charge ceased Gain of 100 lbs

with a bronchus without any cavity whatsoever. The stereoscopic effect permits us to estimate with considerable precision the depth of the cavity and its location (Plate I').

As stated before these bismuth injections are not only of great diagnostic but also therapeutic value. The first injection does not always produce healing. It requires at times repeated injections during several months but whenever the discharge changes from pus to a serous character the injections should be stopped because healing will usually follow. Only when the discharge continues to be purulent should we consider more radical surgical procedure.

I have tried to ascertain why some cases respond to the bismuth treatment and why others do not and I have come to the conclusion that whenever the cavity holds more than 200 grams it will be less likely to heal by bismuth injections. Cases which communicate with the bronchi are also more resistant than simple empyema.

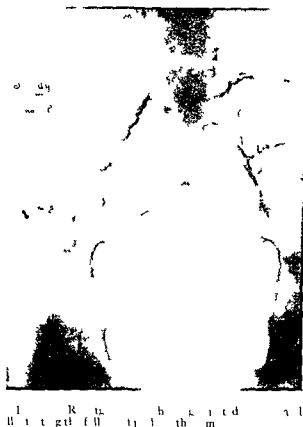
Some cases will heal shortly after the injection and remain closed for a year or two and the patient be in good health often gaining

as much as thirty pounds and then the sinus will reopen. The injections are then to be



Fig 9 Pointing of form of empyema with rubber catheter to sit the tip of the catheter. Wire localizer set in place to locate focus from the skin

The reverse of the empyema is the same as the empyema. The reverse of the empyema is the same as the empyema.



repeated. Closure usually follows for another year or two only to have another relapse after that period. The patient often prefers to keep on treatment in this way not being much inconvenienced and perfectly well in the interval.

But there remain a small number, about 15 cases, which have no tendency whatever to heal under any form of treatment and these require the most radical surgical procedure.

The methods in vogue in dealing with these refractory cases are known as the Islander, the Schede operation or the decortication of the lung. The patient who has to submit to one of these extensive surgical procedures is of course in a desperate situation. He is told that the operation causes a high mortality and the surgeon cannot promise him an absolute cure even with this method. Aside from that the surgeon must warn him of the prospect of a considerable deformity of his chest whether he be cured or not. I have always hesitated to advise such extensive

procedure and in the last seven years I have not resorted to any of the above mentioned operations.

SLIDING SKIN FLAP OPERATION FOR LUNG ABSCESS

During the past seven years I have employed a surgical procedure in the case which is far less dangerous and is I believe more effective than the Islander or similar operation.

The patient is placed in a semirecumbent posture and anesthetized. Before incision the skin a rubber catheter is introduced into the existing sinus and kept there as a guide during the first part of the operation. The skin incision differs in almost every case. It depends entirely upon the location of the abscess or empyema. I have devised and employed three different types of skin incision: the Y shape, the X shape and the trap-door incision. I illustrate here each of these incisions schematically (Figs. 3, 4 and 5).

It will be noted that each of the incisions forms one or more flaps of skin of various lengths which are intended for implantation into the lung abscess after it has been exposed. The skin is not detached from the underlying intermuscular until we are ready to implant it into the abscess cavity.

In three to five ribs overlying the abscess cavity are now widely exposed and as many are resected as seems necessary to expose the lung abscess to its full extent. In case of empyema even more than five ribs may have to be resected. One should not hesitate to remove a much longer rib length as seems feasible to even inches of each if possible. In case of empyema where the cavity usually extends into the apex we should endeavor to include the third rib in the resection if possible. This will facilitate the implantation of the skin flap into the very recess of the apex of the pleura and prevent the granulation of this recess which occurs when the skin flap does not cover it completely.

The rib removed with incision of the thickened pleura muscle along the catheter the finger is introduced into the abscess cavity and the cavity explored.

The incision of the pleura is extended up

ward to the highest point without cutting into the lung and then the cavity is fully exposed to ocular inspection by removing as much of the parietal pleura as possible. This will usually make the opening into the abscess cavity large enough to introduce the entire hand.

In most cases of chronic empyema the lung will be found retracted upward and inward. At times the apex will contain functionally normal lung. In the cases of lung abscess however the matter is different. The globular or multilocular cavity with thick septa exists into which frequently open one or more bronchi. In one of my cases seven bronchi opened into one lung abscess (Case shown at the Western Surgical Association in 1914).

The cavity being fully exposed it should be swabbed with dry gauze and the usually smooth surface of the abscess wall sufficiently scarified either by rubbing it roughly with gauze or even resorting to a mild curettage. This is done for the purpose of producing a favorable condition for the adhesion of the skin flap.

The cavity being dry the tip of the skin flaps are drawn into the very deepest recesses by means of forceps. Gauze is picked tightly against them to keep them in contact with the raw surfaces of the abscess cavity. No suture whatever is used.

The denuded surfaces from which the skin flaps are taken are then covered with sterile gauze and no attempt is made to reduce the size.

At this stage the operation is completed while in the Estlander a great deal more work is necessary to complete it. The procedure should not last more than 100 minutes in the very extensive cases and can be done in 60 minutes in the less extensive ones. From a series of nine cases I cite only two for illustrations.

EMPHYSEMA PLEURÆ WITH SINUS

The procedure just described was carried out on a young man 6 years old who retained a fistulous empyema subsequent to a pleuropneumonia 18 years ago. The case had the usual history of retraction of one rib



FIG. 11. The knife implanted into the abscess cavity 6 days after operation.

rubber drum with no tendency to cessation of the discharge.

I first saw him four years ago (1913). His temperature rose daily to about 100, his weight was 13 pounds. The empyema cavity would hold 2 ounces of the bismuth. Subsequent to the injections the cavity closed and he was in good health for about two years. Since then the abscess has re-opened three times at intervals of 6 months.

The patient's health began to deteriorate and he returned in June 1917 for the radical operation. The cavity was then discharging large quantities of pus, holding about one quart of fluid. A culture showed staphylococcus in pure culture.

The operation took place June 30, 1917. Although the work was done under favorable conditions a film camera having been operated causing frequent interruption yet it took less than an hour to complete it. Four days later the patient was able to walk around in the hall of the hospital. The cavity gradually diminished in size until at the present time it will not hold more than two Mayo sponges whereas at the time of operation I could introduce my entire hand into the cavity. Figure 18 and 19 illustrate some phases of the operation.

The technique will naturally vary a little in every case. Where bronchi communicate with the abscess cavity the technique is



Figure 1
The patient is lying on the back with the head tilted back. The incision is made in the mouth and throat area.

Figure 3
The patient is lying on the back with the head tilted back. The incision is made in the mouth and throat area.

considerably changed. For this reason I shall illustrate such a case, but mention only the principal difference in the technique.

LUNG ABSCESS WITH OPEN BRONCHUS

A girl fifteen years old with a lung abscess. The abscess was located in the upper lobe of the right lung. The patient had a history of coughing and expectoration of pus. The abscess was opened by a surgical incision in the chest wall. The abscess cavity was drained and the bronchus was opened. The patient recovered after a few days of treatment.

Figure 4
The patient is lying on the back with the head tilted back. The incision is made in the mouth and throat area.

The abscess cavity was explored with the finger. No foreign body was found but on inspection the opening to the large bronchus was visible. The abscess was drained and the bronchus was opened. The patient recovered after a few days of treatment.

The patient was treated with antibiotics and the abscess healed. The patient was discharged after a few days of treatment.

The patient was treated with antibiotics and the abscess healed. The patient was discharged after a few days of treatment.

If the abscess cavity remains widely open the cauterization of the bronchus may be done subsequently at different sittings. The procedure is entirely painless and causes no other discomfort than the irritation produced by the smoke from the burning flesh drawn into the trachea and nostril during inspiration.

The correct after treatment in these cases is of the utmost importance. The gauze packing should not be removed for 48 hours. After this period the skin flaps will usually have become firmly adherent and the gauze



Fig. 6

Fig. 16 Removal of diseased metatarsal bones. Tendons held back by gauze strips.

Fig. 17 Implantation of skin flap into ankle joint. Compression by packing gauze against it.



Fig. 17



Fig. 18

Fig. 18 Photograph showing final result. Flexion and extension of knee nearly normal. Child is able to walk with a slight limp.

packing can be safely removed without detaching them although great care should be taken against such a mishap. A spatula should be pressed against the skin flap while the gauze is being pulled out. No irrigation or medication is necessary merely careful picking. This should be repeated daily and it will be noticed that the cavity is growing smaller from day to day and that the skin is gradually growing from the edges of the skin flaps paving the cavity by degrees.

The most gratifying observation is the fact that the reduction of the size of the cavity is not due to filling of granulation tissue but rather to the expansion of the underlying lung so that after a period of several months the skin flaps which were deep down in the cavity are now very much nearer the surface of the chest and only a shallow depression or a short funnel eventually remains.

The minor details and changes in procedure in individual cases must be left to the good judgment of the surgeon. He who attempts this class of work must have mature experience in general surgery. A novice had better not begin his career with such extensive operations.

CHRONIC SUPPURATIVE OSTEOMYELITIS (TRAUMATIC AND PATHOGENIC)

Aside from the vast number of cases of chronic bone and joint suppuration which result from diseases such as tuberculosis, syphilis and systemic pyogenic infection we encounter many chronic suppurative bone lesions due to external injuries such as compound fractures and gunshot wounds also from bone plating and other operations. The traumatic types will no doubt be very prevalent after the present war. The progress made during the past three years in the treatment and especially in the prevention of suppuration after gunshot and shrapnel wounds surpasses anything that has previously been done. Nevertheless there is bound to be a vast residue of cases in which surgical procedures as well as the prophylactic measures have failed.

I shall illustrate by striking examples that some of the apparently incurable cases can be entirely healed by a method of operative treatment which I have employed with great satisfaction in 35 cases during the past five years. The method of procedure differs from the treatment of the cases just described only in technique the principle being



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practically the same. The illustration here presented will be more helpful in teaching the technique of this operative procedure than a verbal description.

The bismuth paste treatment should precede the operative treatment in every case in order to save the patient in operation if possible. I am pleased to say this is accomplished in more than 60 per cent of cases.

It is superfluous to mention again the technique in employing bismuth paste. It has been fully described in my previous publications.

Cuillot and Woumont present a valuable contribution to the subject of early sterilization of the infected wounds and the late suppurations. They advocate first the Carrel Dakin method of sterilization usually followed by injection of different combinations of paste. They give preference to the bismuth paste as they have observed no toxic effects and have obtained good results. They also advocate after sterilization of the wound the implantation of fat and suture of the wound.

Those who have studied their report and observations and who will compare them with the evidence contained in this article will observe the essential difference to be as follows: They

suture the wound while I do not. They use watery irrigation preceding the paste injection while I omit all watery flushings. I believe the sutureless method to be preferable since it does not lock up the paste mixture which after all are foreign substance and may lead to absorption and poisonous effect. The error resulting from the sutureless method are not objectionable as they are very inconspicuous.

We discarded the practice of flushing much with watery solution long ago and have obtained very good result without them. It should therefore be established by those who are using flushings and the paste afterward whether the use of the paste alone will not accomplish as much.

As to the choice of the different pastes which are now being employed in practically all the war hospitals I do not venture to dogmatize. I have now employed the bismuth vaseline paste for ten years with very gratifying result and have found no reason to employ other new mixtures. This however does not preclude the possibility of improvement and I shall be pleased to adopt any other combination of paste as soon as I am convinced that it is superior to the bismuth.

The bip mixture advocated by Ruthenford Morrison of England is said to pro-

duce very favorable results. I used the combination of iodoform and bismuth when I first introduced the method about 10 years ago¹ but on account of its odor to which the patients objected I had to discontinue it. I have found no difference in the results since its discontinuation. I would however warn against the closure of the wounds after the iodoform or bismuth mixture has been injected. Iodoform is even more toxic than bismuth. We have had our sad experience with bismuth intoxication which fortunately we are now able to avoid entirely.

It is of course essential that sequestra should not be allowed to remain in bone cavities otherwise the bismuth treatment will not be effective. To ascertain the pressure of sequestra and foreign bodies it is essential to take stereoscopic roentgenograms and submit them to a qualified roentgenologist. Upon his interpretation of the roentgenograms depends the decision as to whether an operation is indicated or not.

I consider the injection of bismuth for diagnostic purposes in these cases most essential and at the same time enter a protest against the use of the probe as a diagnostic instrument. The probe is very misleading when we wish to ascertain the depth of sinuses or bone cavities. One need only to glance at one of these roentgenograms in which the sinuses have been injected. Figure 10 to convince himself that the use of the probe in ascertaining the course of the tract borders on the ridiculous. The tip of the probe may be resting in the nearest pocket or recess of the tract and leave us under the impression that we have reached the bottom whereas in fact there may be a network of sinuses into which the probe can never be introduced. In fact the sinus at times may be twice as long as the probe itself.

Curettage of the bony cavities without ocular inspection is likewise inefficient especially if it is done blindly by introducing the curette through the sinus opening and scraping in all directions. Such a procedure is mere guesswork. No one can know whether he has reached all the diseased area. Many times I have convinced myself of this by

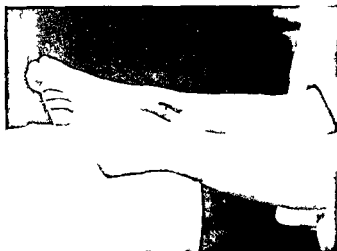


Fig. 2. Curettage without skin flap lower part of tibia. Eight years ago.

exposing the cavities which I had curetted and found that I had curetted in the direction of healthy bone and left the most diseased area untouched. Even exposure of the bone cavity and a very thorough curettage under ocular inspection does not always prevent the recurrence of the suppuration.

The customary procedure for instance of curetting the shaft of the femur introducing a drain at one end and sewing the skin over the wound will in most instances result in failure. A channel usually remains underneath the sutured skin and the suppuration soon returns.

The Mosetig Moorhof plug if properly introduced may be of real service in such cases but I shall describe a surgical procedure which I believe is more dependable.

SKIN SLIDING OPERATION FOR OSTEOMYELITIS

After the diseased area is located by means of the roentgenograms it is freely exposed by cutting away all the unhealthy skin and scar tissue. The diseased bone is then thoroughly curetted or chiseled away until one is certain that there is not a vestige left. Should this produce a deep groove it must be converted into a very shallow one or even into a flat surface by cutting away a sufficient quantity of healthy bone on either side.

After this is done a skin flap is cut from one or each side sufficiently large to cover almost the entire denuded bone surface care being taken however that no subcutaneous



Fig 3



Fig 4



Fig 5

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g t k l l j l l t d l f a T
s s g

I g 4 N t h a l l h e d t b a d e s k i n m
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I 25 I l u l t

fat is carried with it. The flaps are then shifted into the depth of the cavity and retained there by packing gauze against them. It is not absolutely necessary that every part of the bone cavity should be covered. The skin will grow from the edge of the flap until every portion of the raw bone surface is covered with true skin. To prevent retraction or slipping of the skin flaps I have frequently used a carpet tack to fasten temporarily the tip of the skin flap to the bone until adhesion has taken place. The areas of muscle and subcutaneous tissue which have been exposed by sliding the skin are left denuded. No attempt should be made to bring their edge together by suture or otherwise. In only very rare instances has it been necessary to use any suture material whatever except of course the ligation of bleeders.

Forty-eight hours later the gauze pack which has kept the flaps in apposition to the denuded bone surface is removed and it will be found that firm adhesion has already taken place. In one case in which an assistant displaced one of the flaps during the application of the dressing immediately after the operation I was unable twenty-four hours later to replace the skin flap in its proper place until I had loosened it with a raspitory. The rapidity with which adhesion of the skin to the bone takes place is remarkable (Figure 11 this case six days after operation).

The after treatment is most interesting. As soon as granulations on the denuded surfaces from which the skin has been removed begin to form strips of adhesive plaster are applied covering the margins of the skin border and the granulating surface all around the wound. This procedure will produce rapid epidermization of the denuded surface. The adhesive is changed daily. Within two or three weeks large areas will be covered by healthy skin and in practically every instance the suppuration will stop after the denuded area has been epidermized. Small scars of course remain but will gradually shrink so that a denuded surface the breadth of three fingers will have a scar no wider than one half centimeter.

When the wound is not too deep the skin flap may be omitted. It is simply left widely gaping and packed with gauze and allowed to granulate from the bottom. Later on adhesive plaster is put on the edges of the wound.

I have employed this method of skin sliding in a variety of cases: osteomyelitis of the femur, tibia, in hip joint disease, in knee joint disease, in the removal of the os calcis and of the metacarpal bones in osteomyelitis of the ribs and of the sternum and in other cases including infected fractures and other injuries.

I shall now illustrate the efficiency of this procedure by some typical cases selected from my series.



Fig. 6

Fig. 6 Four sinuses from tuberculosis of sternum discharging 15 years. After 5 operations.



Fig. 7

Fig. 7 Skin flap implant after removal of sternum.



Fig. 8

Fig. 8 Final results 6 weeks later. The sinuses closed and the denuded surface as obliterated. The patient gained 20 pounds.

TUBERCULOSIS OF OS CALCIS — REMOVAL AND SKIN FLAP IMPLANT

Lillian P. colored age 8. Stepped on a pin with right heel two years ago. The pin was extracted but a temperature of 104 followed one foot became swollen and an abscess resulted which was drained. Suppuration continued and she remained in a hospital for six months. During her stay at the hospital incisions into the heel were made at thirteen different times then she was discharged as incurable. Ten months later the left hip became swollen and painful. Tuberculosis of left hip was diagnosed. Rest in bed four months. While an abscess was prevented the limb gradually became thinner and shorter. In September 1917 we find the right heel twice the normal size with three profusely discharging sinuses (Fig. 11). Stereoscopic roentgenograms show destruction of the entire os calcis (Fig. 12). The left limb is three inches shorter than the right the muscles atrophied. Stereoscopic roentgenograms disclose a healed tuberculosis of the hip joint the head being entirely absorbed and joint ankylosed. Diagnosis Tuberculosis of right os calcis associated with healed tuberculosis of the left hip.

Operation. A tongue shaped flap with its base upward at the back of the heel was dissected. The tendo Achillis which was still firmly attached to some of the fragments of the os calcis was divided. This gave splendid access for the removal of the entire os calcis (Fig. 13). In tent of suturing the flap was pushed into the cavity produced and gauze picked against it. Within twenty-four hours the skin flap was adherent and filled part of the large cavity. The defect grew smaller each day and finally healed completely and the foot assumed

nearly normal shape (Fig. 14). The child is now able to walk since a pair of shoes has been provided for her. The right shoe has a padding in the heel to make up the deficiency. The left foot was provided with a regular 3 inch high sole shoe to overcome the shortening due to the hip disease.

TWO CASES OF TUBERCULOSIS OF THE ANKLE

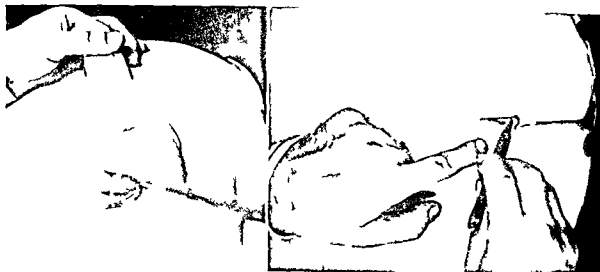
Florence B. age 5 had tuberculosis of the right ankle which progressed so rapidly in spite of all treatment in a well equipped hospital that within two years from its inception amputation of the foot was recommended. The child was unable to walk and profusely discharging sinuses persisted after several minor operations had been performed.

On March 15 1917 I performed a radical operation by the skin sliding method. Figure 16 illustrates the flap incision with exposure of the metatarsal bones the tendons being held back by a gauze strip. The metatarsal bones were removed and the skin flap implanted (Fig. 17).

The final result of this case is shown in Fig. 18 the child being able to walk with only a perceptible limp and able to flex and extend the foot to almost the same degree as her healthy foot.

A very similar case is that of boy 8 years old in which the disease had destroyed practically all the metatarsal bones and the os calcis. The condition was so deplorable that nothing but an amputation seemed advisable (Fig. 19).

A complete excocleation of all the diseased bones was done by large opening on both sides of the foot a small skin flap being provided in the incision on either side. These flaps were inserted deeply into the cavity. The final result is shown in Fig. 20 and all the sinuses having closed the boy being able to



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TUBERCULOSIS OF THE TERNUM

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l h g t r v a r l n t l t h u c
k f t u p l t b n l t h l t g r e
T h i n t l t i g h t a l l u f d g r t
d l f l

O J u a v 20 o I f r r a l t h s k n h d g
o p r t a i l l u t t d i l g T h k n
g t h n o c e d t h l r
p r t i t h t n v p l l r t l l t h e
d e l b d f a l h a t m d t t d
A t r i a n g l a p o f h l t h k t h n t l m
u n l r n t l t h l f t l r t n d h d o n t o t h
d p t h f t h t y n d k p t t h r l m j r e i o
o f a g e p a k i n g T h d n i d f o f t h e
b r a s t a o t s u t u r d W t h i k t h e n t e
d n d d u a c e a b h t r e d p t l y b y t h c n
t t o n o f t h s k i n d g s n d f a r t l b y g r o t h
f k f r o n a l l b o r d s (F i g 8)

In t h s c a e v i l l u s t r t h o v t h p l t d k n
s l p v i h a t t h t i m e o f o p e r a t r e a l d n t a
d p u n e l l k e d e p r e s s o n h g r a d l y r e
t o a d t h e u f a c s o t a t p t t i l m o t
l e l t h t l e r t o f t h s t n a l u r i f a c T h e
p t i n t g n l o d a t h s i m p e d f r o m t h
t i m e f t h p a t n a n d s h e h a g u i d s o m
p o u n d s i n e g h t

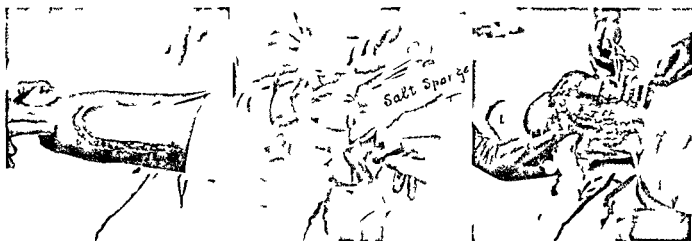


Fig. 31

Fig. 32

Fig. 33

Fig. 31 Flap incision for the exposure of the femur
Fig. 32 Wide exposure of diseased femur. Skin flap covered with warm salt gauze

Fig. 33 Complete eradication of disease leaving no groove in the bone

DERMOID CYST MISTAKEN FOR RECTAL FISTULA

Mr. B. age 60 was operated on ten years ago for what was then supposed to be a rectal fistula. The operation was very extensive having produced incontinence and later a stricture of the rectum. In 1914 the condition became very much aggravated a very profuse discharge of pus from the rectum, pain and severe eczema around the anus and gradual emaciation compelled him to seek further treatment.

Intra-rectal examination revealed a sinus opening in the posterior rectal wall about two inches above the anus. The pus virtually poured from this sinus. The injection of bismuth paste into the cavity revealed a large area undermining the anterior aspect of the sigmoid and cecum. Diagnosis at this time coccygeal tuberculosis with abscess formation. Operation. Instead of the longitudinal incision usually employed for the removal of the coccyx I made a triangular flap with the apex pointing toward the anus. Raising the skin flap I resected the fat and the coccyx and found underneath a fibrous structure resembling an indurated cyst wall. A urethral metal sound was then introduced through the rectal sinus and the wall of the rectum pushed up ward into the wound and incised. The skin flap was pushed into the depth of the wound to meet the opening just made into the sac.

Our diagnosis was then changed to dermoid cyst. The sac having continued a few long hairs. Figure 20 illustrates the condition a week after the operation the skin flap having already healed in the depth of the wound now about 10 inches deep. The pus now discharged through the external opening in lead of the rectum. The bismuth injections were carried on through the external opening and within a short period the suppuration stopped and both the intra-rectal and extra-rectal opening healed. The large wound contracted gradually and at present there is only a small depression in the region of the coccyx as shown in Figure 30.

OSTEOMYELITIS OF FEMUR

Mr. B. The case here illustrated represents a type of chronic suppuration from the femur not very uncommon. The sinuses usually form near the hamstring tendons and the disease is most persistent lasting indefinitely. Operations for this class of cases are particularly unsatisfactory. I have adopted a procedure entirely different from that heretofore employed.

The bismuth treatment had in this case been tried for six months without much effect. It was discovered that the shaft of the femur up to the middle of the thigh was filled with sequestra and pus. The knee joint was also affected. The operation here illustrated was preliminary to a resection of the knee joint which was done later. Amputation was refused by the patient.

It is unnecessary to describe the steps of the operation since the legends below the illustrations explain the technique as well as the underlying principles in the treatment (Fig. 31 to 36).

The disease in the femur is now entirely healed. Re-section of the knee joint as well as the operation on the tibia were performed later the same principle having been carried out.

TUBERCULOSIS OF THE HIP OF FIFTY YEARS STANDING OPERATION

Mr. D. age 54 fell out of bed when about four years old and soon after developed tuberculosis of the hip which resulted in the entire destruction of the hip joint which remained quiet for about 3 years. The limb remained infantile and contracted at the age of 40 abscesses formed and many sinuses opening around the hip resulted. The condition improved spontaneously until three years ago when he developed a severe pain in the hip and new abscess began to develop. From this time on condition grew rapidly worse and he began to lose in weight and suppuration increased. He presented



I 34

Fig. 34. Sk. of t t d p t l l l d t t
t k t l t
I 3 W l k t p t l g
g d a l t l m t t d d d f

13

l g 3 l h t g p l t k s k f t p t
h m p l t e f d l m t Th
th f mu e t ly h l d

1 2 36

hms lf n O tol r 10 6 v th f ur u pro
fus lv dt ch rgi grt vtl hltly t l ntl
s r t nd n n x l mlt i n l nrt s
conll n

Th t r o r t o g r m l o a l r g e
n t o r k f i n r o l i n g t h f m n l t h
c t l l u n i n j t i o f b n t h v c t u b r
a n d n g i l l u t l t h b n g n u b r
o f s l t r v t l h u n l t l a t h o s
i d c l u r b i s n t h l t r I r i d
t h n t t a l p r i l r d l k i n l i n g
o p a t i T h h i j j u t d b y u t t a g
a l l t l l l k t h y g u t l t i b u
l u m f l f m a l l r t l t h h l
h a v i n g b n l t v l j l A h k h y k i n
f l j a l u l l t r o t h r g f t h l t t o k
n i m p l t l t o t l p t l t h t v (l a t e A I)

as ho n n l l t VII h h u l l t r t f h e c o n d
s p f l p a t t l n s t l f t h e c o n
o f t h e g r t t r o h u n t l t h i y l l t a t i o n o f
a n o t h e r v l g e k i l p t p i v t h l o c p a r t
o f t h e p o d h p k t T h i s p b u t i r b y s
i n c h s i d i n e t r i l u d f r n t h l e r p a r t
o f t h e s u d d e n l i n p l a n t i n t h i a l m e r
I l a t e V I I I i l l t t s t l o h t i t k l a t e r
a n d I l a t e I X t h r e a t t l f t e r c o m p l t h i n g
h a d t k p l a

The patient generally appears bright in person
for health but of course has a very cold right now

factory results in trying out this method I therefore anticipate that now when the method has been perfected and when there is such an abundance of material in which it can be employed its usefulness will be readily established

SUMMARY

To sum up I would advise the following procedures

1 The methods of primary sterilization by means of aqueous flushings of wound should be thoroughly tested to determine whether or not they are effective and practical without the additional use of pastes

2 That the wide excision of tissues as now practiced in the war hospitals should be adhered to as a means of preventing chronic suppuration

3 That in cases in which early sterilization was not obtainable and the wounds persist in suppurating the bi-muth injection treatment or its similar substitutes should be employed before any radical operation is resorted to.

4 That in the residue of cases in which the bismuth treatment is not effective the sutureless method of skin sliding as described in this paper should be employed since with this method we are able to clear up nearly all of these apparently hopeless cases.

During the evolution of this sliding method of treatment I have from time to time presented some of the cases before medical associations and since then a number of my confreres have reported to me their satis-

GASTRIC FUNCTION FOLLOWING GASTRO-ENTEROSTOMY

AN ANALYSIS OF 73 CASES¹

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TO April 1, 1917, there had come under my observation 886 individuals affected with digestive disorders. Of this number there were 73 patients or 8.1 per cent upon whom gastro-enterostomy had been performed for the relief of dyspepsia. These patients returned for re-examination of their own accord or upon request in order that their digestive functions might be ascertained or they came because digestive upsets were troublesome. They represented 11.6 per cent of 2360 individuals upon whom operations had been done for diseases of the stomach or the duodenum. These diseases were gastric ulcer, 571 cases; duodenal ulcer, 1469 cases; and gastric cancer, 320 cases. It is not to be inferred that the remaining 88.4 per cent of patients in this group were well; no attempt has been made to trace them inasmuch as this report is concerned with observations upon the functions of the gastro-enterostomized stomach without particular effort being directed toward proving whether or no in the whole number of patients operated upon the surgical procedure was the best type of therapy.

General observations. Of the 213 patients composing this series there were 170 males and 103 females (Table I).

The average age at which gastro-enterostomy had been performed was for males 44.3 years and for females 41.5 years. When the patients returned for postoperative examination the average age was for males 46.1 years and for females 44.3 years. It is thus evident that of the 273 cases the males returned on an average of 1.8 years following operation and the female on an average of .8 years. The shortest interval intervening between operation and re-examination was for male 3 weeks and for females 11 weeks. The longest interval between operation and re-examination was for males 9 years and for females 7 years. The above facts exclude 58

cases that were studied postoperatively before leaving the hospital at an interval of from 3 to 6 weeks following laparotomy.

Primary operative procedures. As Table II demonstrates posterior gastro-enterostomy without or with pyloric closure or local or extensive gastric resection and combined with removal of the appendix or removal or drainage of the gall bladder was the operation of choice in 95.4 per cent of cases. In 4.4 per cent anterior gastro-enterostomy was similarly employed. In one patient or 0.36 per cent through faulty anatomical orientation at another clinic a gastro-ileostomy had been done under the impression that a gastro-enterostomy was being performed. This patient survived nearly one year.

Patients subject to anomalies of digestion at re-examination. It should be again emphasized that 58 patients were examined within 6 weeks following operation. It is not to be expected that perfect digestive function had become established in so brief a time. However, reference to Table III shows that of 57 gastro-enterostomized patients (20.9 per cent of the series) clinically complaint free there were 18 such whose operations had been very recent. Moreover of 78 patients (8.9 per cent) who were subjectively in good health but who experienced mild digestive upsets (usually stated as being "dietetic") there were 6 or one third of the group whose laparotomies had taken place within 6 weeks. Of the entire series (273 cases) 104 patients (38.09 per cent) were definite dyspeptics although they stated that operation had been followed by improvement. This class includes 9 patients (9.6 per cent) recently operated upon. There were 6 patients (6.9 per cent) in whom gastro-enterostomy has been followed by no improvement whatever in digestion and upon 3 of this class the operation had been performed less than 6 weeks previous to examination. Fourteen pa-

TABLE I—SUMMARY OF MATERIAL STUDIED

Tal	m cl	550
C	l c r t d t l t t m f g a t	
D	d l l	49
C		3
C	a m n d t t g t r t t m	
F	c t k l l k f l m s p c a t	3
A l m n t	l l k f l m s p c a t	
F l l	g p t f k t l l	6
F l l	g p c t f k t l l	
F l l	k p c t f k t l l	3
S		
M l		
I m l		3
A	k a k t l t	44 3 3
M l		4
I m l		
A	g g h m d	47 3
M l e		44 3
I m a l		
A	b l t l f t u n f l l g t	
M l		8 3
I m a l		9
L	g t t l	
M l		
I a l		
S h t e t t l		
M l		3 k
I m a		k
C	t l l b f l n k l t t l	
d	t f k t l l k l t l	8

tients (51 per cent) appeared to have experienced in alleviation of their dyspepsia postoperatively. Of the patient recently operated on in this group upon one had been performed simple posterior gastrojejunostomy without pyloric closure on account of non-stenosis pyloric ulcer and upon the other posterior gastrojejunostomy had been combined with resection of the pyloric fifth of the stomach for *ulcus circinomatousum*.

It is evident from study of Table III that of the 73 gastroenterotomized patients re-examined but 99 per cent were complaint free 49.8 per cent were clinically comfortable and in 87.9 per cent subjective benefit had accrued from the operation. If the 58 patients recently operated upon are deducted on the ground that it is as yet too early to establish their status there still remain 196 patients (68.49 per cent) who have been subjectively improved by gastroenterotomy and associated surgical procedures.

TABLE II—DIETARY PROCEDURES

Type	10	N m b e f f
I t	g t j j t m y	9 33 3
A t	b t j j t m y	5
I t	g t t t m th j e	
t p y l	l u	8 3
I t	k t t t m th t	
f u l	r t t t m h	6 9
A t	g t t t m y th e c t	
f u l	r t t t m h	3 99
I t	k a t n t t m y th p p	38 39
d t m y		
I t	r k a t n t t m y th h l	4
y t t m y		
I t	g a t n t t m y th h l	6 9
y t t m y		
I t	r k t t t m y th p p e	8 9
I t	t m y d l l y t t m y	
I t	r g t t t m y th p p	8 9
d t m y	d l l y t t m y	
A t	g t t t m y d j p e	73
I t m y		
A t	k t t t m y th h l	36
y t t m y		36
C t l t m y	th p p e l t m y	
T t l		7 99 4
f p y l n c l	b	
f a s c l b d s		

Postoperative symptoms in patients not dyspepsia free There were 16 such patients. The type of their postoperative digestive upsets and their clinical symptoms are analyzed in detail in Table IV. It has seemed advisable to group the symptomatology according to the gastric or the duodenal ailment for which operation was performed. The summary makes apparent that where the surgery had been done for relief of cancer and of postpyloric duodenal ulcer abdominal distresses involving nausea vomiting gas water brash and constipation were more frequent than where the operative indication had been gastric or pyloric ulcer. Eructation of food and diarrhoea were rather more frequently observed in the gastric ulcer case. It should be emphasized that very few gastric cancer patients returned for re-examination following operation. They were all in a bad way, what became of the original group (320 cases) of which they formed a part it is not possible to state. Doubtless fully half of the original group is dead. Weight loss had been experienced by nearly one sixth of the gastric or pyloric ulcer class by more than one fourth of the duodenal group and by all of the cancer patients.

TABLE III — CLINICAL CONDITION OF PATIENTS

St t	N	m b	f P	t
Clinically complaint free (includes 18 patients recently operated on)	5	20	9	
Well — but with minor digestive up ets (includes 26 patients recently operated on)	9	38	09	
Improved — but still dyspeptic (includes 9 patients recently operated on)	04	38	09	
Not improved (includes 3 patients recently operated on)	0	6	9	
Dyspepsia aggravated following operation (includes patients recently operated on)	14	1		
Total		09	89	

SUMMARY

Clinically comfortable	4	43	8
Improved	104	38	09
or			
Subjectively benefited (primarily)	40	8	89
Deducting 58 patients (38% of total)			
recently operated on leaves —			
Subjectively benefited (permanently)	101	60	9
Not improved	4	0	

The incidence of gross hæmorrhage (hæmatemesis or mælena) following the operative procedures warrants consideration. It would apparently indicate delay in healing, recrudescence of the original ailment, malignant change or the occurrence of new pathologic processes (doubtless most commonly ulcer). In more than 6 per cent of the gastric or pyloric ulcer cases more than 1 per cent of the postpyloric duodenal ulcers and approximately 16.5 per cent of the gastric cancers gross hæmorrhage had occurred postoperatively. In 6 patients the hæmorrhages were exhibited within four weeks following the laparotomy. It is customary to ascribe such bleeding to faulty operative technique or to accidents. It is certainly not possible always to explain the event in this way. The occurrence of gastrorrhagia following surgical procedures upon the appendix, gall bladder or pelvic organs might indicate causes for such hæmorrhage that are apart from the purely mechanical.

Signs of digestive mal function (Table V). Less than one third of the patients exhibited gross physical evidences of digestive anomaly. Of 63 patients whose blood was examined in but 30.8 per cent was the hæmoglobin below 80 per cent. There was nothing especially noteworthy in the blood counts. Rather more than 10 per cent of the patients were

TABLE IV — POSTOPERATIVE SYMPTOMS IN THE PATIENTS NOT DYSPESIA FREE

	G t	D d	G tric
	pyl n	l	l
	N	(6)	(35)
C mpt t	N	P	t
Fain or distress	132	61	5
Anorexia	27	12	8
Nau ea — constant			
or irregular	41	18	9
Vomiting	43	19	9
Sluggishness typ	20	9	2
Gas bloot etc	6	31	0
Water bra h	34	15	7
Eruptions	95	43	9
C nstipation	44	0	3
Diarrhœa	19	8	9
Weight loss	35	16	2
Weakness	39	8	0
Ner ous	18	8	2
Gro s hæmorrhage	13	6	01

definitely *cachectic*. This is not remarkable when it is recalled that there were 12 cases of hopeless gastric cancer in the series. *Jaundice* was distinctly present in 11 cases (4.03 per cent). In 5 patients there was malignant disease involving the pancreas, gall tract or liver. In the remaining 6 cases postoperative adhesions, perforated ulcer involving the pancreas, gall stones and biliary cirrhosis explained the jaundice. *Visible abdominal peristalsis* was observed in 19 patients (6.9 per cent). It seemingly resulted from gastric hypermotility associated with stenosis of either the pylorus or gastro-enterostomy stoma or both or occurred in the jejunum as a consequence of adhesions or imperfect surgical maneuvers. In the patient upon whom gastro ileostomy had been performed distention and billowing of the abdomen were striking. Fæcal vomiting was a

TABLE V — OBJECTIVE EVIDENCES OF DIGESTIVE MAL FUNCTION

S en	N	m b	P	t
Anæmi (Hb 80 per cent or lower — of 63 cases examined)	21	30	8	
C he ia	28	10	3	
Jaundice	11	4	03	
Visible abdominal peristalsis	19	6	9	
Abd minal tend rnes	82	30	0	
Abd minal rid e or mass	44	16	1	

OBSERVATIONS UPON STOMACH SIZE

Inflat n method — 179 cases t ted	
Stomach small r	8 or 47.4 per cent
Stomach larger	3 or 0.6 per cent
No change	5 or 31.9 per cent

TABLE VII—OBSERVATIONS UPON GASTRIC ACIDITY

FREE HYDROCHLORIC	
No postoperative reduction	14 per cent
Postoperative increase	5 per cent
Reduction in	
Cases examined soon after operation	35
Cases examined 1-3 yrs after operation	2
Cases examined 3-5 yrs after operation	14
Cases examined more than 5 yrs after operation	1
General average of acid reduction	0
In cases exhibiting vicious circle averaged	37

TOTAL ACIDITY	
No postoperative reduction	per cent
Postoperative increase	3 per cent
Reduction in	
Cases examined soon after operation	4
Cases examined 1-3 yrs after operation	13
Cases examined 3-5 yrs after operation	8
Cases examined more than 5 yrs after operation	10
General average of acid reduction	0
In cases exhibiting vicious circle averaged	8

demonstrated in 43 or 16.4 per cent. It was present in 10 of the 12 cancer cases in the series. Gastric hypersecretion i.e. the recovery of more than 150 cubic centimeters of contents following an Ewald meal was proved in 29 cases or 11.06 per cent.

Of the entire series the average quantity removed from the stomach was for the stagnation cases 347 cubic centimeters and for the non stagnation cases 1.6 cubic centimeters.

Chymification was good in 56.6 per cent fair in 33.3 per cent and poor in but 10 per cent. This observation is not without interest in view of the criticism which is often made that gastro-enterostomy markedly alters gastric peristaltic activity as demonstrated by the roentgen ray. It is suggested that real food acts differently upon gastric mechanism than does an inert heavy mass of bismuth or barium.

Bile staining of the gastric extracts was definite in 57.7 per cent of meals examined. The colors ranged from a light golden yellow to grass green or olive. It is interesting to observe that even in high acid meals bile coloring was frequently intense in fact the macroscopic presence of bile coloring was no

TABLE VIII—OTHER CHEMICAL TEST MEAL OBSERVATIONS

	P	C
	t	T
Bile (Goodell's Test)	42	182
Altered blood (Benzidin test)	45	2
Lactic acid (ether extract)	3	4
Volatile fatty acids (heat test)	2	
Wolff Junhan's test		
Positive	7	1
Questionable	18	6
Negative	74	9
Formol index (Sorensen Schuff method)		81
Averaged	14	2

index of the degree of gastric acidity either free hydrochloric acid or total.

Nearly one third (30.5 per cent) of the gastric extracts were uncolored except as the shade varied with the test meal given. In 11.8 per cent of meals discoloration resulted from food remains, cell detritus, bacterial or ferment action and possible altered bile or blood.

Macroscopic blood was present in 10.7 per cent of the stomach contents. It was apparently of traumatic origin.

Observations upon gastric acidity. Inasmuch as numerous workers particularly Bolton (3) and Paterson (4) have emphasized the importance of hydrochloric acid in the causation and the healing of peptic ulcer, comparison has been made between the test meal findings respecting acidity before and after gastro-enterostomy (Table VII).

It will be observed that there occurred no postoperative decrease in free hydrochloric acid in 14 per cent of cases and that in 5 per cent there was a definite increase. There was a demonstrable reduction in free hydrochloric acid in 81 per cent of all cases examined. This reduction averaged 20.5. The table also demonstrates that the reduction in free hydrochloric acid was greatest soon after operative procedures and that there was a steady diminution in the degree of acid reduction in direct proportion to the time interval following operation. The greatest average reduction—37—was recorded in the cases exhibiting vicious circle.

Respecting total acidity it is evident from Table VII that there occurred no postoperative reduction in 17 per cent and that there existed a postoperative increase in 3 per cent. In 80

per cent of the cases there was however definite *postoperative* reduction in total acidity. It averaged 10. The greatest degree of reduction occurred soon after laparotomy. In general this degree became less pronounced as longer time intervened between operation and re-examination. Cases exhibiting vicious circle showed a total acidity reduction averaging 28.

The above facts clearly demonstrate persistent reduction in both free hydrochloric acid and total acidity following gastrojejunostomy. If excessive concentration of free hydrochloric acid is an important factor in the production of and the prevention of healing of peptic ulcer then it might be assumed that gastrojejunostomy properly used holds valuable therapeutic possibilities. What effect upon the reduction of acidity and toward the healing of peptic ulcer bile (noted macroscopically in 51 per cent of this series and chemically proved to be present by Goodell's test (5) in 42 per cent of 18 meals analyzed) exerts is open to question. Iaterson (4) in a rather indefinite research stoutly maintains that bile (mixed with pancreatic juice) is present almost invariably in the stomach after gastrojejunostomy. He states that the reduction in total acidity averages 30 per cent and that this is partly due to neutralization of free hydrochloric acid by bile and pancreatic juice and partly to earlier stimulation of the pancreatic secretion and compensatory (?) earlier lessening of the gastric secretion. Iaterson also states that after gastrojejunostomy there is an almost constant increase in the mineral chlorides of the gastric contents and as a rule a diminution of the total chlorides. The increase in the mineral chlorides disappears after undoing a gastrojejunostomy. He claims that the average increase in the mineral chlorides is 0.077 per cent and that such increase is evidently due to bile and pancreatic juice gaining access to the stomach through the anastomotic opening. It would seem that according to Iaterson this increase in mineral chlorides is an important factor in reducing gastric acidity and thus aiding ulcer healing. However Tanton and Tidy (6) maintain as the result of much painstaking research that

there is no really reliable technique by which mineral salts (chlorides phosphates) can be accurately estimated in gastric contents. They assert that in low acidity cases the amount of phosphates present is probably independent of the clinical condition and that phosphates introduce a fallacy common to all methods investigated. Further that when free hydrochloric acid is low or absent the active hydrochloric acid is overestimated because the fixed chlorides interact with phosphorus compounds with the consequence that the phosphates are increased. Panton and Tidy also suggest that phosphates in excess are secreted into the gastric cavity when the stomach mucosa fails to elaborate free hydrochloric acid from the mixture of phosphates and chlorides brought to it from the blood. It would thus appear that Pater-son's opinion respecting the source of increased mineral chlorides in gastroenterostomized stomachs is open to question and that even the increase which he maintains exists (0.077 per cent) is well within the possibility of chemical error. Hamburger (7) has recently confirmed the work of Schutz (8) and of Levites (9) with reference to the inhibiting action of various alkaline salts on peptic digestion. He claims that such alkalis definitely inhibit peptic digestion and in a later communication with Halpern (10) suggests that inasmuch as phosphates chlorides and carbonate inactivate pepsin a therapeutic advantage in the cure of peptic ulcer can be secured by their use. Inasmuch as it seems evident that phosphates (and perhaps chlorides) are increased in gastroenterostomized stomachs as free hydrochloric acid is decreased it would appear that the experiments of Hamburger and Halpern might explain some of the beneficial effects of gastroenterostomy toward ulcer cure. It is still unsettled whether bile and pancreatic juice contain antipepsin when regurgitated into the stomach. Bile was present in 9.5 per cent of the gastric contents from 140 non-stenosing ulcer cases that I analyzed (11)—and yet two-thirds of the ulcers lay in the pyloric fourth of the stomach where they could secure the maximum benefit of bile regurgitation should it contain antipepsin.

Further chemical observations upon test meals (Table VIII) As I have already mentioned *bile* was proved to be present in 4 per cent of the gastric extracts from 18 gastro-enterostomized stomachs

Altered blood was demonstrated in 45.2 per cent *lactic acid* in 3.4 per cent (mainly the cancer cases) and *olatile fatty acids* in per cent (also the cancer cases)

Wolff Junghans test for soluble albumin was negative in nearly three fourths of the cases

The *formol index* demonstrated a slight increase over the eruptic power common to peptic ulcer but no increase over that observed in cancer It averaged 14.2 in 81 cases analyzed Such increase might be taken to indicate the presence of pancreatic juice although the rather high percentage (45.2) of extracts exhibiting blood positive altered blood test may explain the increase

Microscopic examination of gastric extracts exhibited nothing characteristic In the benign stagnation extracts yeasts and sarcinae were often abundant In the malignant retention extracts organisms of the Oppler Boas group were plentiful Regurgitated bile and pancreatic juice appears to have no effect upon the gastric flora In 5 cases where stagnation existed in the jejunal loop the presence of a peculiar short fat deeply staining acid fast bacillus appeared constant When it had been observed several times its presence in large numbers led to the diagnostic suggestion that jejunal stenosis with dilatation might be present which suggestion was substantiated at laparotomy

Stool analyses Altered blood was demonstrated by the benzidin test in 31 of 107 cases studied Of these 72 patients were upon test diet

To 8 patients Schmidt's test diet was given In 17 cases (60.7 per cent) there was evidence of deficient proteolytic digestion

Bile pigment (Schmidt bichloride method) was present in all but 8 of 151 stools examined either as hydrobilirubin or biliverdin In 7 instances where bile pigment was absent there was deep jaundice In the remaining cases there existed intestinal obstruction and

pronounced cachexia (instance of gastro-ileostomy)

Röntgen examinations Fluoroscopic study was made of 39 cases within 7 weeks of gastro-enterostomy and of 6 cases operated upon from 6 months to 9 years previously The results were so greatly at variance with the patient's physiologic digestive function or his clinical condition that we are still in doubt as to the clinical worth of the procedure Apart from the screen and plate examinations demonstrating the patency or closure of the pylorus or gastro-enterostomy stoma contractions of the stomach incorrect surgical procedures new ulcer or recurrences of ulcer or cancer or anomalous pocketing or regurgitation of the opaque meal little reliable information respecting gastric function was obtained Many of these facts were clinically evident from simple routine examinations and from well taken histories

In patients who have been operated upon at other clinics and in whom the surgical maneuvers are in doubt fluoroscopic examinations furnish a valuable method for rapidly establishing the mechanical status of the stomach and the jejunum However in all cases where stenoses contractions pocketings or retention of the opaque meal appear to exist frequent examinations particularly after full doses of atropin or belladonna should be made before opinion is given Many abnormalities seen at the first seance disappear upon repeated examination especially upon the examination after antispasmodic medicines have been administered

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THE CHOLESTEROL CONTENT OF THE BLOOD IN GALL-STONE DISEASE¹

BY STANLEY P. REIMANN, M.D., AND J. A. H. MAGOUN, M.D., PHILADELPHIA
F m h D p m t (P h l g r f h L L H p d P h i d l p h)

AN increase in the amount of cholesterol in the blood is stated to occur in the presence of gall stones and this point has been used as a diagnostic sign in upper abdominal disease (1, 2). A classification of such cases based on blood cholesterol determinations and a dietetic management has been worked out by Rothschild and Rosenthal (3). A hypercholesterinæmia has however been noted by numerous observers in a variety of conditions: nephritis, arterio-sclerosis, syphilis, diabetes and many others, conditions which may well complicate cholelithiasis (4, 5, 6, 7, 8). Denis concludes from 254 determinations in various pathological conditions that hypercholesterinæmia is found in only a relatively small number of diabetics and the cases investigated included nine cases of cholelithiasis in which a hypercholesterinæmia was not at all indicated.

Using the original Autenrieth Funk method (10) blood cholesterol determinations have been made in six patients operated on in the clinic of John B. Deaver to whom we express our thanks for the clinical data. Normal values by this method have been expressed ranging from 130 to 190 milligrams per 100 cubic centimeters of blood. Several higher figures (230) have been given for individuals (6, 10). Bloors' method (11) in use by several observers who have reported results recently (9) gives readings 7 per cent to 30 per cent higher than those by the Autenrieth Funk procedure. One person (Magoun) has made the determination in our series and the personal error has thereby been reduced to a minimum. For convenience in most instances blood was collected in the morning after the patient had been in the hospital at least over night. We have adopted 200 milligrams of cholesterol per 100 cubic centimeters of blood as the upper limit of normal.

The following table gives averages in the

cases with and without stones and gall bladder lesions.

Number of	6
Gall stones	
Arteriosclerosis	1—219 milligrams per 100 cubic centimeters
Cholelithiasis	1—99 milligrams per 100 cubic centimeters
Cholelithiasis	1—5 milligrams per 100 cubic centimeters
Cholelithiasis	1—9 milligrams per 100 cubic centimeters

The stones found varied from 1 to 400 in number and were variously light yellow to black in color, smooth, faceted or mulberry type, from gravel to large stones 4 to 5 centimeters in diameter. The gall bladders in these cases showed lesions varying from mild acute to violent suppurative inflammations, from mild chronic inflammatory changes to changes which led to very marked thickening and fibrosis. One case of carcinoma of the gall bladder occurred among these. The gall bladders in which no stones were harbored also showed mild to advanced chronic and acute inflammatory lesions. The other upper abdominal lesion found included gastric and duodenal ulcer, high appendicitis, carcinoma of head of pancreas, chronic pancreatitis.

From the above figures it is evident that a high cholesterol content of the blood has not helped in the diagnosis for the cases of right upper abdominal disease other than gall stone disease gave higher cholesterol readings than the cases of cholelithiasis themselves. The highest cholesterol reading obtained in the series was 447 milligrams per 100 cubic centimeters of blood in a case of carcinoma of the head of the pancreas; the lowest was 111 milligrams per 100 cubic centimeters of blood in a case of chronic cholecystitis with stones.

Ten patients were jaundiced all with obstruction of the common duct from stones or carcinoma of the head of the pancreas. The average cholesterol reading was 76 milligrams per 100 cubic centimeters of blood. A hypercholesterinemia has been found in obstructive jaundice (7-12) with which our results agree; there was no relationship between the degree of jaundice as observed in the skin and sclera and the hypercholesterinemia, however. The patient with the heaviest jaundice, a case of carcinoma of the head of the pancreas, showed a value of 239 milligrams, while a patient less jaundiced also with carcinoma of the head of the pancreas showed a content of 474 milligrams. Plasma jaundice estimations were however not made and a discrepancy between jaundice of the blood and of the skin and sclera may often exist (13).

Cholesterol has been found to increase in the body fat with increasing age (14). The following table shows averages of blood cholesterol in our patients over and under forty years of age, our idea having been that the age may affect the values and thus the diagnostic significance.

Number under 40 years	
With stones 9 average	9 milligrams
Without stones 5 average	99 milligrams
Number over 40 years	
With stones 13 average	34 milligrams
Without stones 23 average	90 milligrams

Those patients over 40 years of age therefore showed a higher cholesterol value than those under 40. In the younger patient those without stones showed higher quantities than those with stones; the reverse was the case in the older patients, but both of these latter groups showed values above our arbitrary 100 milligrams.

Anemia produces a low blood cholesterol content (9). Six cases showed hemoglobin below 65 per cent (Dare) and red cell counts under 3,000,000. Their average of cholesterol values was 213 milligrams. Including one case jaundice the average is 19 milligrams. Two of these patients had stones (10 and 180 milligrams).

A hypercholesterinemia has been observed and commented on in malignant tumor cases by various observers (15). Essentially

normal values were obtained by Denis in 14 cases (9). Robertson and Burnett have found that the growth of malignant tumors transplanted in mice is hastened by the injection of cholesterol (16). They have expressed the opinion that the increased incidence of tumors as age advances is due to an increase of cholesterol (17).

Among the 60 patients were 9 with tumors: carcinomata of stomach, gall bladder, oesophagus, appendix and pancreas (2 cases), hypernephroma of kidney, myoma uteri and papillomata of gall bladder. The average cholesterol reading was 59 milligrams. Excluding the jaundiced cases (2) the average was 31 milligrams. None had gall stones.

Since gall stones are more common in women, the cholesterol content of the two sexes in the series had an interest.

3. Females	
6 with stones average	225 milligrams
21 without stones average	66 milligrams
3. Males	
6 with stones average	200 milligrams
7 without stones average	203 milligrams

Viewing the cases from another angle and using 100 milligrams as the upper limit of the normal by the method used, 14 of the 78 cases with stones showed a content above 200 milligrams or about 63 per cent; in the 38 cases without stones 26 or about 68 per cent gave readings below 200 milligrams.

Cholesterol mg per 100	with stones	without stones
61	285	474
105	240	214
210	131	179
232	334	108
10	138	38
2	111	39
3	31	180
40	4	240
9	2	190
19	44	203
0	23	3
		212
		14
		43

SUMMARY

Cholesterol determinations in the blood of 60 patients with histories relating to upper abdominal lesions were made and their subsequent operative findings correlated to determine the presence or absence of hypercholesterinemia in cholelithiasis and their

value as a diagnostic point. Certain complicating and parallel conditions are considered in their relation to the cholesterol readings.

CONCLUSIONS

A hypercholesterinæmia is not constantly present in cholelithiasis. Many conditions may affect the quantity of cholesterol in the blood. Therefore a hypercholesterinæmia has no significance in the differential diagnosis of cholelithiasis.

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ANGULATION AT THE SIGMOID¹

By H. BLICKMAN DLATOUR M.D. F.A.C.S. BROOKLYN

THE sigmoid flexure is the narrowest part of the colon beginning at the termination of the descending colon at the margin of the crest of the ilium and ending in the rectum opposite the left ischio-symphysis. It is retained in place by a loose fold of peritoneum the sigmoid mesocolon. Treves defines the sigmoid as extending to the third sacral vertebra thus including what is usually described as the first part of the rectum. It lies not in the iliac fossa but partially or completely in the pelvis. It is not usually S shaped but a large loop 17½ inches long more like the Greek Ω the top of the loop sometimes even touching the right side of the pelvis (Treves).

At either end of the sigmoid is a constriction which Cantlie describes as a sphincter to which he gives the same importance as to the pylorus. He describes the sigmoid as an

organ with a definite function and not a mere channel for the passage of feces. The mucosa of the sigmoid is not so loose as in other parts of the colon.

It is a well known fact that the sigmoid mesocolon varies much in length and this leads to varying degrees of mobility with occasionally a twisting of this upon itself producing volvulus.

If as Cantlie claims there is sphincteric action at either end of the sigmoid it must be possible for spasm to occur here and thus to impede the flow through the intestine at this point just as we see cardiospasm and pylorospasm at the stomach.

These anatomic and physiological factors may easily lead to a partial or complete stoppage of the fecal flow through the large bowel and thus become an important factor in the production of intestinal stasis.

If the bowel twists completely on itself we have produced volvulus with the symptoms of



Fig. 1. Case 1. Roentgen film illustrating the volvulus of the sigmoid.



Fig. 2. Case 2. Roentgen film illustrating the volvulus of the sigmoid.



Fig. 3. Rectosigmoid junction with mesocolon.

acute intestinal obstruction but if the sigmoid becomes distended and displaced with the two extremities attached as they are close to the abdominal wall it is easy to see how the bowel may become bent upon itself and an angulation instead of a twisting result. This angulation produces a partial obstruction with the symptom of intestinal stasis.

Angulation at the sigmoid may occur at either the upper or lower attachment. When the bowel becomes distended and coils back into the abdomen along the descending colon we may have the angulation at the proximal end of the sigmoid; this is rare. It is more common for the distended sigmoid loop to drag downward and to bend the bowel acutely at the rectosigmoid junction. If there is true sphincteric action in the bowel the irritation of this condition may bring about in addition spasm of this band of muscular fibers. Whatever may be the cause it is certain that in many cases angulation does occur and is responsible for chronic



Fig. 4. Sigmoid.

intestinal symptoms. Occasionally an ulceration is the result of external bands which pass across the sigmoid or to contraction following a mesosigmoiditis.

Intestinal stasis is a cause of varying degrees of ill health, a recognized fact. The majority of surgeons are agreed that to overcome this it is not necessary to do the radical operation proposed and practiced by Lane. Experience has shown that the fault may be at some particular section of the large bowel and that a correction of this defect produces just as good results with less mortality than the operation of complete colectomy.

Resection of the caecum ascending colon and a portion of the transverse colon is necessary in some cases; in others the freedom of adhesions at either the hepatic or splenic flexures or the overcoming of a prolapsed transverse colon is necessary, while in others as we have already shown the cause is found in a relaxed sigmoid that angulates itself at times and requires resection of that portion of the bowel for relief.

We are convinced by our own experience as well as that of some of our colleagues that this

condition exists more frequently than is generally recognized. It can always be demonstrated by the X ray.

The symptoms are persistent and obstinate constipation, weight in the pelvis or left iliac region, pain in the back over the sacrum and occasionally a tumor may be felt in the left iliac region. This is the distended sigmoid and will often disappear after the use of an enema.

Angulation may be so acute that complete obstruction is produced and then all of the symptoms of intestinal obstruction appear.

The treatment consists in resection of as much of the sigmoid as is necessary to straighten the canal and prevent a recurrence of the condition. In a few of our early cases we produced an anastomosis between the two limbs of the sigmoid but have been better pleased with the results after resection. The operation is easy of performance and is accompanied by very little shock.

It is well to pass a rectal tube beyond the point of suture before the abdomen is closed and to leave this in place for 48 hours. This relieves the patient of gas and prevents any pressure on the line of suture.

We have records of about 40 cases from which the following will serve as illustrations.

CASE 1. Woman age 36, a patient of Dr. J. J. Masterson had suffered for many years with intestinal symptoms, flatulence and obstinate constipation, pain in the sacral region and a feeling of fullness in the pelvis. Had been operated upon before coming under our observation and the appendix was removed and the gall bladder drained with out benefit. The roentgenogram (Fig. 1) showed a redundant sigmoid passing high in the abdomen.

Operation with resection of twelve inches of the sigmoid was followed by a disappearance of the symptoms and relief of the constipation.

CASE 2. Male age 65, a patient of Dr. H. W. Price was seized with pain in left iliac region, distention, inability to move the bowels for several days, tenderness and a mass in the left side of the abdomen. There was no fever and the patient was able to be about. After the bowel was moved the tumor gradually disappeared and the intestinal symptom cleared up. The roentgenogram (Fig. 2) showed in the rectum a similar condition of the sigmoid. The mass which had been plainly felt by three different examiners was thought to be a malignant growth of the colon. It had therefore appeared on all the X ray examination, however, no obstruction or

irregularity of any point of the bowel other than the enlarged sigmoid.

CASE 3. Reported by Dr. R. M. Rome. Male had suffered for fifteen years with chronic intestinal stricture with marked auto-intoxication with frequent and severe attacks of gout. A year ago (before the report) was operated upon and a redundant sigmoid found and ten inches resected. He has not had an attack of gout since the operation, no evidence of intoxication and only occasionally has to use a cathartic.

Fig. 3 is an X ray of a child (patient of Dr. Chas. Cochrane) showing that the same condition is present early in life.

CASE 4. Boy age 6 had always been markedly constipated and would pass three or four days with out an evacuation. The use of an enema would produce a free evacuation but as this was always followed by a convulsion the mother would delay its use as long as possible.

Operation revealed a general ptosis of the transverse colon and a long displaced sigmoid. Seven years ago operation was performed so as to relieve the condition at the sigmoid, the center of the prolapsed transverse colon was anastomosed to the lower segment of the sigmoid thus producing a straight canal. Since then there have been no convulsions and only occasionally are cathartics necessary. He has developed normally and today is perfectly well.

CASE 5. Woman age 55, a patient of Dr. Roger Durham has had several attacks of constipation lasting for several days with abdominal pain and at times a mass in the left iliac fossa. Between attacks patient suffers from discomfort and constipation which latter dated from the primary attack. Two days before admission a sudden sharp pain occurred in the left iliac region spreading soon over the entire abdomen. This was dull in character and was succeeded by vomiting when any nourishment was taken. Vomitus was not fecal. All attempts to move her bowels had failed. Examination showed an elderly appearing woman of fair nourishment who did not seem critically ill. The abdomen was generally distended, not tense and fuller on the left side. A mass as large as a child's head could be felt in the left iliac region, tender to touch and so much so that a careful determination of the nature and limits of the mass was impossible. Attempts to move the bowel by enemata were ineffectual. Under anesthetic the same mass could be felt by vagina and seemed to be a distended coil of intestine. During this manipulation a gurgling sound was heard and the mass disappeared coincidently with a copious evacuation per rectum.

The patient was sent back to bed, the bowels were thoroughly emptied and a roentgenogram taken of the sigmoid. This revealed an hypertrophied loop of sigmoid about a foot long. This was evidently the cause of the attacks of bowel



Fig. 1



Fig. 2

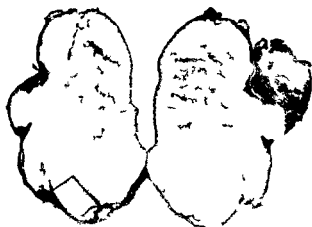


Fig. 3

Fig. 1. Mass removed from the lumen of the trachea.
Fig. 2. Thyroid gland removed on the left.

Fig. 3. Cross section of the thyroid gland.

Dr. J. N. Sherman, who has had charge of the patient recently has treated him with mercury and cacodylate of soda because of the luetic history. Under this treatment the patient gained 15 pounds in weight (of this he has now lost 6 pounds) and is less troubled by cough and dyspnea. One Wassermann test was said to be positive and another was negative. At the time a belated report was received regarding the intestinal tumor removed nearly six months previously. They were reported to be malignant and to consist of thyroid tissue or at least of tissue belonging to the endocrine system.

Diagnosis: Sarcoma of the humerus. Malignant neoplasm of the left lobe of the thyroid.

History: The tumor was excised from the humerus (Fig. 2). A hard well-defined cavity about 10 cm. in length was left in the humerus. The cavity was filled with a mass of brownish and the wound closed without drainage. Healing per primam.

Course: Under general treatment in the left lobe of the thyroid was excised. It consisted of a nodular tumor (Fig. 3 and 4) of almost wooden hardness. In situ of the parathyroid gland. The patient recovered and left the hospital on January 1, 1917.

Pathology: Dr. Sherman reports that the tumor is a sarcoma of the humerus that has a large amount of the tumor in the humerus. It is a hard tumor that is a mass of the tumor in the right kidney that the urine has a white color and contains some albumin.

Microscopic: The tumor is a sarcoma of the humerus that is a hard tumor that is a mass of the tumor in the right kidney that the urine has a white color and contains some albumin.

Prognosis: Dr. William H. Welch of Johns Hopkins University was good enough to examine a section of the neoplasm removed and reported as follows:

Section from the thyroid gland: This is a section of a tumor said to occupy the left lobe of the thyroid gland. There are no recognizable follicles containing colloid so that the section does not reveal the origin of the tumor.

The section shows a neoplasm composed predominantly of large fusiform cells arranged obscurely in interlacing bundles (Fig. 5) although there is no very definite architecture. In addition there are many large polyhedral and polymorphous cells, sometimes in clump and likewise some scattered and foetal lymphoid cells. There are some areas usually round which may correspond to the original follicle but the cells are filled with tumor cells and it does not appear that epithelial cells participate in the composition of the tumor. The nuclei are in general large, often very large even gigantic and contain much chromatin. There are quite irregularly shaped budding nuclei. There is some connective tissue stroma but in general the cells greatly predominate.

Section said to come from near the upper end of humerus: Here again there is nothing in the section to indicate its site. The tumor growth in this section is of the same general character as that located above as from the thyroid—large spindle cells, round oval or irregular polymorphous cells often in clump and column and connective tissue stroma (Fig. 6). There are also large cells in the budding nuclei. There is some tendency to an arrangement of cells in small columns and clump in the outer wall of the vessels.

Section of the small intestine: Here the coat of the intestine can be made out. Overall in two-thirds of its extent the section has a tumor occupying the site of the mucosa in most of the submucosa and projecting distally 6 mm. in the lumen. The remaining part of the section shows relatively intact mucosa and submucosa and through out the muscular and serous

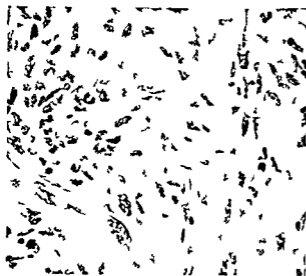


Fig. 1. Section of the thyroid gland.

is the little nodules that are found on the surface of the tumor. The nodules are of various sizes, from a few millimeters to a centimeter. They are composed of a dense collection of small, dark-staining cells, which are arranged in a somewhat regular pattern. The cells are small and round, with a high nucleus-to-cytoplasm ratio. The cytoplasm is scanty, and the nuclei are hyperchromatic. The overall appearance is that of a highly cellular, solid mass.

In this section (Fig. 1) the tumor is seen to be composed of a dense collection of small, dark-staining cells, which are arranged in a somewhat regular pattern. The cells are small and round, with a high nucleus-to-cytoplasm ratio. The cytoplasm is scanty, and the nuclei are hyperchromatic. The overall appearance is that of a highly cellular, solid mass.



Fig. 2. Section of the thyroid gland.



Fig. 3. Section of the thyroid gland.

vascular system. It is placed especially near the middle of the tumor, and it is a distinct feature of the tumor.

The tumor is a solid mass, and it is composed of a dense collection of small, dark-staining cells, which are arranged in a somewhat regular pattern. The cells are small and round, with a high nucleus-to-cytoplasm ratio. The cytoplasm is scanty, and the nuclei are hyperchromatic. The overall appearance is that of a highly cellular, solid mass.

Dissection of the tumor shows that it is composed of a dense collection of small, dark-staining cells, which are arranged in a somewhat regular pattern. The cells are small and round, with a high nucleus-to-cytoplasm ratio. The cytoplasm is scanty, and the nuclei are hyperchromatic. The overall appearance is that of a highly cellular, solid mass. The tumor is a solid mass, and it is composed of a dense collection of small, dark-staining cells, which are arranged in a somewhat regular pattern. The cells are small and round, with a high nucleus-to-cytoplasm ratio. The cytoplasm is scanty, and the nuclei are hyperchromatic. The overall appearance is that of a highly cellular, solid mass.

Upon dissection of the tumor, it is found that the tumor is a solid mass, and it is composed of a dense collection of small, dark-staining cells, which are arranged in a somewhat regular pattern. The cells are small and round, with a high nucleus-to-cytoplasm ratio. The cytoplasm is scanty, and the nuclei are hyperchromatic. The overall appearance is that of a highly cellular, solid mass. The tumor is a solid mass, and it is composed of a dense collection of small, dark-staining cells, which are arranged in a somewhat regular pattern. The cells are small and round, with a high nucleus-to-cytoplasm ratio. The cytoplasm is scanty, and the nuclei are hyperchromatic. The overall appearance is that of a highly cellular, solid mass.

metastasis of a sarcoma still of course metastasis can occur anywhere.

While I think it is possible that the intestinal tumor is an independent growth it seems to me that the characters of all three tumors are reconcilable with the view that they are all of the same nature and this is a simpler conception than that of multiple primary neoplasms.

It will be noted that while the tumor of the thyroid was removed about six months after that in the intestine yet its presence had been noted before the acute intestinal obstruction demanded enterectomy. Thus the sequence of events is not against the assumption that the thyroid tumor was primary.

If the tumor in the thyroid had been metastatic it would probably *not* have involved the *hole* of the affected lobe as it did in this case but would have been in the form of a nodule or nodules scattered throughout a mass of more or less normal or at least recognizable thyroid tissue. For these reasons there seems little doubt but that the primary disease was located in the thyroid while the

osseous and intestinal neoplasms were metastases.

Paul F. Morfi made a careful review of the literature relating to sarcomata of the thyroid finding records of but 40 cases which he considered certainly authentic and among these there were only two which presented metastases in the gastrointestinal tract. One of these cases reported by Kobler was that of a spindle celled sarcoma of the right lobe of the thyroid with metastases in the liver the upper ileum and the right kidney the second case was reported by Pick.² The tumor was a spindle celled sarcoma with bony tissue in the left lobe of the thyroid and had been present many years. There were metastases in the lungs heart liver stomach intestine pancreas dura mater and palate.

In six cases metastases were noted in the bones or cartilages.

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CANCER IN THE SURGICAL CLINIC OF THE SAN JUAN DE DIOS HOSPITAL

WITH REPORT OF CASES

By DR. J. B. MONROY Y FLORES, MEDICIN, COL. MEX. SOUTH AMERICA
M m b e f t h M l l l l s f P (99) P f f c l l s g r y A t o q U l s

IN my surgical clinic at the Hospital of San Juan de Dios during eleven years there have been extirpated 47 benign tumors 15 external and 32 internal. In the internal are included 4, uterine fibromata (3 per cent) and 9 benign ovarian tumors (11.7 per cent). During the same interval there have been operated upon 168 malignant tumors 10 external and 158 internal. In the internal are included 43 uterine cancer 5 per cent of the total malignant tumors 5 situated in the cervix and 11 in the uterine body 1 gastric cancer 6 per cent 5 of the liver etc. Of the external malignant tumors 6 were mammary cancer 15 per cent 1, were maxillary osteosarcoma especially

superior 7 of the lower lip 5 of penis etc. There were therefore operated on an average of 15 cancers per year. The total of the neoplasms operated on in 11 years is 415 that is an average of about 37 per year. As the total operations of all kinds in the same length of time is 191 the neoplasms equal 21.6 per cent or a little less than one-fourth of all the operations carried out in the clinic. From this analysis it appears that the form of cancer most frequent in the Antiquaria is that of the uterus 17.5 per cent next that of the mammary gland 15 per cent sarcoma of the upper maxillary 10 per cent cancer of the stomach 7.6 per cent of the lips 4 per cent of the liver and penis re-



Malignant (lip) tumor

spectively per cent etc. Scarcely is frequent in the lower lip attaining large size and has a grave prognosis since recurrence is frequent unless there is wide extirpation. Patient with such tumor are very sensitive to anesthetic.

The parotid adenoma is of enormous mixed tumor. Its extirpation has a fair prognosis (see the photograph).

In civil practice epithelioma of the tongue and of the tonsil is frequent in smokers and drinkers. The cases which come to the hospital are usually inoperable and can only be treated by means of thermic electrocoagulation as G. I. Pflaher of Philadelphia recommends or better by the method of Doven. The latter method leaves a better appearing cicatrix and differs only in the manner of placing the electrodes. In the United States the method of Fercy has given good result. His method consists in applying a low degree of heat with electrocautery regulated by means of a special rheostat of great simplicity. The method is much used by the Mayo Brothers for the electro-surgical treatment of inoperable cancer of the uterus. Donald C. Balfour has published an excellent study of the cases treated in the Mayo Clinic by this method.

The electrocautery, the thermocautery and the actual cautery are serviceable only in emergency since their action is very superficial and greatly limited on account of the

scar produced by the burning. The scar insulates the neoplastic tissue surrounding it with asbestos as it were unless the sections are repeated ten, twenty or more times or the scar itself is removed in order to continue in the same section.

Radium is very efficacious in certain cases if the tube is placed within the orifice. The ultrapenetrative X-rays can also be used. However as Doven has observed electrocoagulation is the method of choice owing to its particular effect of heating the tissue which are in contact with the small electrode without forming carbonization scars yet raising the organic fluids to a state of ebullition and cooking coagulating the cancer in a few minutes. The lesser vitality of cancer cells dominates the question of the local thermic treatment of cancer. While it appears that a temperature of 60 is necessary to kill normal cells 50 to 55 centigrade appears to be sufficient to destroy the virulence of cancer cells, the coagulate and become disintegrated without secondary hemorrhage unless the small electrode is placed in a rich vascular region which is a contra-indication as also the proximity of vital nerves such as the pneumogastric. In such cases air heated to 600 ought to be employed. This is indicated in intractable cavities in regions rich in blood supply and nerve trunks but it works only superficially and does not penetrate more than 3 to 5 millimeter. While electrocoagu-

lation is more difficult to manage penetration can be controlled up to eight millimeters depth according to time and intensity of current. In this lies the secret of its greater efficacy and superiority over all other procedures employed today.

Fulguration employed since July 1907 by my master Professor Pozzi is very efficacious for superficial lesions but useless for deep lesions since it does not penetrate to more than five millimeters and forms protective scars. American surgeons especially recommend it for the treatment of the wound after the extirpation of a cancer or for the treatment of a recent cicatrix. In such cases it is applied in the form of large sparks of high frequency with the brush electrode or vacuum tubes and not with pointed electrodes and short sparks which produce a considerable thermic effect and are perfectly useless in such cases.

Its heralded superiority is due to its marvelous and rapid action in the treatment of benign papillomata of the bladder; its action is specific and is now accepted as the very best, as can be seen from the works of all the great urologists especially Edwin Bear, its promoter in New York, and Legueu, the most notable in this specialty and to whom I owe extreme gratitude particularly to my most noble master Professor Felix Legueu, the dear friend and admirable orator of the Faculty of Paris.

The only unquestionable progress today in the treatment of accessible cancer is the electrosurgical method which has made a rapid flight into favor and has given most satisfactory results. Its adoption however is and has been slow whether it is a matter of the surgeon being an electrician and mechanic following the delicate technique of Doyen or whether the surgeon must be aided by a technical assistant as in the large clinics of Europe and of the United States. The most important thing as William J. Mayo says is that every precancerous or suspected lesion should not be neglected and that once the early diagnosis of cancer is made it be treated if accessible by electrocoagulation. On this principally depends the permanent result of the treatment and physicians ought

to realize exactly their responsibility in this respect.

Selenium eosin cupressa or electrocuprol and Doyen serum which have been tried to a large extent here in Medellin both personally and by colleagues have given no benefit whatever and appear to be extremely pernicious since precious time is wasted allowing glands to become infected and the neoplasm to spread to vital organs.

I give below a resume of some cases which I have treated by electrocauterization and fulguration combined simple fulguration and electrocoagulation.

CASE 1. F. P. V. man age 64 married white Colombian. A brother and an uncle died of cancer one in the chin region and the other in the tongue. He was neither alcoholic nor syphilitic but a great cigar smoker. He was a farmer by occupation. For many years he has suffered from a fissure in the left angle of the labial commissure. For two years past the corresponding part of the cheek on the inside has become ulcerated and since a year ago a warty tumefaction has appeared in the labial commissure and in the lower lip as far as the middle. On April 2, 1915 I cauterized him with the electrocautery repeating every fifteen days. The cheek ulcer disappeared at the fourth seance and that of the commissure at the tenth. The lip lesion was treated by two fulguration sessions each of a minutes duration under local cocaine anesthesia. Primarily it appeared inoperable unless by an extensive autoplasty since its aspect was very serpiginous and the glands on the same side had apparently become involved. Now they are imperceptible, the general state satisfactory, the color rose. Up to May 30, 1917 no recurrence has been noted.

CASE 2. A. J. de M. woman age 65 married white Colombian. Antecedents of no importance. Marked arthritis. Seven years ago there appeared on the right side of the upper lip a small purple red plaque which was indurated. Later it became covered with a thick scab which the patient pulled off frequently. In December 1915 it showed the appearance of an orbicular ulcer with hard edges and was very painful bleeding at the least touch. Six seances of fulguration with local anesthesia were administered. There was a slight cicatrix. The recovery has been maintained.

CASE 3. J. R. B. man age 37 single white Colombian. Antecedent history unimportant. Fifteen years ago there appeared a serpiginous ulceration on the lower lip simulating a chronic eczema and resisting all treatment. Submental glands showed slight infarcts. On May 6, 1916 cauterization was done with electrocautery and repeated at eight day intervals. At the third seance there was complete cicatrization which lasted until

URINARY EXTRAVASATION¹

By JOHN A. WOLTER, M.D., I.A.C.S., CHICAGO

I WISH to present the subject of urinary extravasation for your consideration because of its importance as a complication to various pathological processes of the urinary tract. This association carries the same relative consideration as perforative peritonitis in diseases within the peritoneal cavity, the latter condition being only partially mastered after due consideration was given its cause, method of development and its attack before complete intraperitoneal dissemination of the infection. Because of the high mortality rate in cases not properly treated early and the loss of anatomic parts in many cases which survive the ravages of the disease I wish to call attention to the possible underlying pathology, early symptoms and a simple though efficient course of treatment. I shall omit the upper urinary tract and confine my remarks to extravasation from the male urethra and bladder.

Normal sterile urine causes reaction in the tissues chiefly by virtue of its mechanical irritation when constantly infiltrating over a period of time and in relatively large quantities. Here the reaction and subsequent necrosis is chiefly produced by pressure. Sterile water or even sterile salt solution injected subcutaneously over a period of time or under pressure will produce a similar necrosis of tissue. Concentrated urine will bring about this condition earlier than urine of a normal specific gravity and chemical content. The absorption of urea may sooner or later bring about a toxæmia but usually after the reaction from the local condition is of sufficient gravity to overshadow it. In order to convince myself that an ordinary amount of sterile urine produces no necrosis I injected three guinea pigs subcutaneously with varying quantities of such urine using from 20 to 60 cubic centimeters. There was a prompt absorption with no local reaction. Similar quantities of urine standing twenty-four hours caused no reaction. Intraperitoneal injections of 2 to 10 cubic centimeters of sterile urine produced no destruc-

tive lesions in guinea pigs. On the contrary septic urine is very destructive to tissues. The organisms plus the products of ammoniacal decomposition which are frequently bacterial in origin produce a rapid inflammatory œdema and necrosis and sloughing soon follow.

A careful study of some 12 cases under my care during the past four years has led me to classify urinary extravasation into two major groups:

1. Extravasation of normal urine from the bladder or urethra when there has previously been no stenosis of the urinary outlet.

2. Extravasation of septic urine which is practically always associated with urethral stenosis.

Class 1. The causative factor is trauma such as a rupture of the urethra or bladder from a fall or crushing injury, being frequently associated with a fractured pelvis. It may be instrumental. The infiltration of the urine which is not especially irritating to the tissues causes a slight reaction and only when necrosis begins and the destructive ferments are absorbed does the patient develop signs of acute local disturbance and sepsis. Some of these cases I am convinced cure themselves spontaneously by a closure of the perforation and the normal progress of urine. One must not forget that most of the cases go on to a fatal termination if not treated promptly and efficiently, destruction of life being due to sepsis.

As an example of this group I wish to call your attention to a case under my personal observation:

A man admitted to the Cook County Hospital with a diagnosis of bruise. This diagnosis is made because the patient had a cough and fever. At the time of application for admittance he gave no symptoms referable to the urinary tract. After being in the hospital a short time he began to complain of discomfort in the region of the bladder and on examination marked tenderness about the lower abdomen. Since the patient stated he had not urinated for some time he was catheterized and a very small quantity of bloody urine was obtained. The patient then gave a history of an injury several

days before Operation disclosed a rupture of the bladder. His local symptoms manifested themselves only after necrosis began.

Another patient entered the hospital two weeks after an injury developing signs of urinary extravasation just prior to entering. One patient entered three weeks after injury only then presenting signs of extravasation another four weeks after injury. Ten days before coming to the hospital he noticed a swelling of the perineum and lower abdominal wall. Incidentally this man was sent in with a diagnosis of pneumonia. He had passed his urine up to the time of entering the hospital. The local condition had grown decidedly worse during the day prior to coming to the hospital. This case terminated fatally.

These patients had patent urinary outlets with clean urine and the symptoms became grave only when gangrene resulted. One patient entered the hospital three days after an injury in a very critical condition and promptly died. In this case there was a question as to the previous condition of the urine. Most likely it was septic.

I do not care to go into further detail with this type of extravasation but would call attention to the mode of treatment which is apparent to all. In rupture of the bladder if the urine shows no septic material the perforation should be closed. If perforation is intraperitoneal the peritoneal cavity should be wiped out and closed without drainage unless of course there is present an unmistakable peritonitis such as is found in the liteses. In extraperitoneal perforations the wound is closed and a gutta percha drain is left in place for 24 hours. In the late cases wide incisions should be made into the oedematous and gangrenous areas. In rupture of a previously normal urethra the perforation should be closed with fine catgut and a retention catheter left in position for 48 to 72 hours. If the tear is extensive I would insist on a suprapubic cystostomy keeping the tube in place 4 or 5 days or even longer to allow the urethra to heal properly leaving a tube or catheter in the urethra down to the sphincter of the bladder but not into the bladder. The reason for this I will discuss in another part of my paper. The results are uniformly good if the patient is operated on within a reasonable length of time after the injury or before necrosis has taken place.

Class 2 This class constitutes by far the larger group in my experience and in order fully to understand its mechanism it is well to consider the urinary act. Under normal conditions the desire to void urine is produced by a stimulation to the interior of the bladder especially in the region of the trigone. This is usually brought about by intravesical tension. In diseased processes such as cystitis there is a frequent desire to urinate produced by (1) increased irritability caused by septic urine and (2) bladder sensitiveness due to the inflammation or ulceration. We all know that an inflamed bladder will not even tolerate warm water or salt solution. If we remove the intravesical tension stimulation the patient experiences much less discomfort.

Stenosis of the urinary outlet especially of the infective type is sooner or later followed by infection behind the stricture. This applies to any part of the urinary tract. We know how frequently kidney infections follow stenosis of the ureter and cystitis after enlarged prostates and urethral strictures. Strictures of the urethra are rarely single in number there are usually two or more beginning in the penile part with others at the level of the triangular ligament and in the membranous part. As the stenosis becomes more complete granulations form between and behind the strictures and the urethra becomes tortuous and pockets form the bladder wall becomes thickened and a fibrous degeneration takes place especially in elderly and poorly nourished individuals. The bladder wall loses its elasticity. These processes predispose to complicating pathology such as prostatitis seminal vesiculitis perineal abscess and the like. Their relation to extravasation will be referred to later. With these points in view let us now turn to the causes of extravasation in this group.

1 Structure of the urethra with retention suprapubic puncture of the bladder. When I was an intern in the Cook County Hospital it was a stated fact among the interns that a suprapubic puncture meant death to the patient. This was told me early in my service after I had resorted to this procedure late one night in a case of urinary retention. The following day a member of this society did

the deep stricture pass a filiform from the bladder through the stricture and thread a grooved sound over it. In this manner the stricture can be properly dilated and no urine will pass through the perforation which in these cases rapidly closes. When I am sure the perforation is healed and the urethra dilated to pass a French 30 sound I allow the suprapubic wound to close and it will close spontaneously. In some instances where there is a large tear in the urethra with an especially resistant stricture after once passing through I leave a rubber catheter in position. The catheter does not enter the bladder but extends to the sphincter. I believe a catheter into the bladder is undesirable as some urine escape around the catheter and through the fistula. It also has a tendency to allow a closure of the suprapubic wound unless a tube is in place.

3. *Stricture of urethra with perforation due to infection.* In my mind this group affords the most interesting material the study of which prompted me to present this paper.

In going over the histories of the Cook County Hospital for the past four years I have found thirteen cases not including my own seven cases. The mortality is 35 per cent.

These patients were admitted to the hospital with varied diagnoses two entered as pneumonia due to onset with chill one as typhoid because of fever without assignable cause one as malaria because of frequent chills one developed in the hospital in a patient suffering from a myocardial disease one died in the medical service without surgical interference a diagnosis not having been made until the patient was moribund.

The mechanism of this type of extravasation deserves consideration. As I have previously stated in this paper there is usually infection behind a stricture. Granulations are frequent and possibly ulcers are present. Due to the excessive intra urethral pressure during attempts at urination in the presence of either partial or complete retention there may be a perforation through the base of an ulcer. What more frequently happens a peri urethral abscess forms. The abscess due to its peculiar location may not make itself apparent to

inspection and not be found by the ordinary examination. This is especially so when the process takes place in the posterior compartment of the perineum. The patient may have a chill and sweats with fever. The abscess spreads it may burrow into the pelvis or make its appearance in the perineum or upper scrotum. The urethral side of the wall thin and necrotic is broken by the urinary pressure in the urethra and extravasation take place into the cavity and subsequently into the surrounding tissues. The perforation of the urethra into the abscess or vice versa may take place before the presence of the abscess is determined as in Case 5. This deep seated unrecognized infection accounts for the repeated errors in diagnosis. With the perforation there is a rapid edema of the perineum scrotum and penis even the anterior abdominal wall and inner surface of the thighs at times. The patient manifests symptoms of shock. The temperature may fall and the pulse be accelerated. Rapid disintegration of the tissues results and only too frequently in spite of efficient treatment death results. One patient told me that after the breakdown as he called it he could urinate but passed nothing *per urethram* and he was much concerned as to where it went.

The symptoms before perforation are somewhat confusing and can be attributed to a variety of conditions. The fever and other septic symptom may be caused by cystitis acute non suppurative prostatitis or seminal vesiculitis ascending urinary infections or pyelitis. When we have a patient with a partial urinary obstruction who develops a chill and fever the perineum should be examined very carefully as previously described. Unless great care is taken this essential diagnostic point is lost. It must be remembered that at this time the symptoms and findings are those of periurethral abscess. When such a patient suddenly develops a urinary retention something must be done and that must be surgical. We must drain the infection and relieve the retention. A sharp pain in the perineum with the sense of something breaking often associated with a chill and drop in temperature increase in pulse rate with rapid developing edema of penis and scrotum.

means rupture of the urethra and beginning urinary infiltration

The treatment is the same as for the previous type suprapubic cystostomy and free drainage of the oedematous and infected parts

I wish to give brief histories of seven such cases which have been under my care during the past four years omitting all history except as bearing on condition in question. The histories are exact copies of the data and observations recorded by the resident physicians and are given for the purpose of illustrating the indefinite symptoms in each case

CASE 1 P S age 40 laborer entered Cook County Hospital March 16 1914. One week ago the scrotum began to swell and to be painful. The swelling increased and by Monday two days ago the scrotum began to grow black. The patient has no trouble in passing urine and believes he urinates as much now as before. Sixteen years ago the patient had gonorrhoea. Since then whenever he is exposed to cold and wet in his work as a laborer he would have acute retention of urine which usually would last only one day and the next day he would be able to urinate but for next few days urination was painful. These attacks were rare in summer.

Examination of genitalia Blackened area of gangrene on penis the size of a quarter. The scrotum is swollen about four times normal size red tense and tender. There is gangrene of the dependent one third. There are sinuses on the upper surface from which urinous pus escapes. There is infiltration of the lower part of abdominal wall up to internal inguinal rings. This area is red swollen and indurated. Temperature 97 pulse 120. There is a tight stricture at the membranous urethra. Catheter treatment incisions. Recovery.

CASE 2 E T age 32 bowling alley man entered Cook County Hospital July 9 1914. The patient comes complaining of pain swelling and tenderness over scrotum and penis which began two days ago and has rapidly increased up to the present time. The patient says he has been unable to pass urine normally for two days. At times he could pass some and at other times only by drops. He had gonorrhoea nine years ago followed by strictures infected again three years ago. The scrotum and penis were markedly swollen and marvellously tender. The lower abdominal wall was tender. The bladder is distended. Temperature 100.5 pulse 115. Suprapubic drainage incisions in scrotum. Recovery.

CASE 3 H M age 34 teamster admitted October 5 1913. The patient has been unable to urinate for past two days a small amount dribbling through urethra at times. Much pain present constantly. A desire to urinate comes on about

every minute. The trouble began seven years ago with gonorrhoea. The patient has known since then that he had a stricture but this is the first time he had retention of urine. The bladder is distended the penis and scrotum oedematous the skin red and shiny. Temperature 98.4 pulse 96. Perineal drainage. Recovery.

CASE 4 S J age 42 laborer admitted November 17 1916. The patient admitted to medical service with diagnosis of pneumonia. He complains of chills sweats and fever. There is pain in the belly and lumbar region. There is slight cough and constipation. Six days ago patient had a chill which lasted about half hour. The chill was severe enough to cause him to shiver. The chill occurred at 6 a.m. but the patient went to work but had to quit at 9 a.m. From that time on he has had these shaking chills four to five times a day followed each time by a profuse sweat lasting 15 minutes to half an hour after which he feels hot. He had severe pain in his belly and in the lumbar region since he had been sick described as a dull ache but made worse on deep respiration and on movement. His cough has been very slight not painful. He has never noticed blood and has expectorated a very small amount of whitish sputum. He had had no bowel movement since he took sick until given an enema this morning. Ten years ago while in New York he had about three chills at intervals of one to two days but was cured by medicine. He has had none since. He had suffered from lead poisoning 14 years ago. He had gonorrhoea at 35 but cured himself in two months. The lungs were negative. He is tender through abdomen and markedly so over gall bladder region. The mass is palpable here. The genitals are negative. The rectal examination is negative. Temperature 101 pulse 118. November 18 1916 blood from urethra after urination. November 20 1916 urinary retention. November 21 1916 marked oedema of the penis and scrotum the patient cannot urinate and is tender over the bladder. November 1916 penis very oedematous and shows beginning gangrene. Drainage of bladder. Death.

CASE 5 I was unable to find the history of this case so will have to depend on memory and a few brief notes. This patient was admitted to the Medical Service of the Cook County Hospital with a diagnosis of typhoid. Here he remained for several days. The white blood count was slightly increased. There was negative Widal reaction. His temperature ranged rather high. He complained of no distinct discomfort but became very toxic. Rather suddenly one afternoon he developed an oedema of the perineum scrotum and penis. The scrotum soon became discolored and he was transferred to the surgical service July 6 1913. His condition was very critical. An incision into the perineum entered a large abscess cavity filled with pus and urine. A finger inserted entered the urethra and the bladder. Death resulted in a comparatively short time.

CASE 6 M M age 68 machinist admitted to Cook County Hospital October 27 1916 The patient has been in the hospital before complaining of difficulty in urinating He now complains of frequency of urination dribbling swelling of prepuce and scrotum He says swelling of the scrotum has been present about three weeks and has gradually increased in size up to the present time The scrotum is tense red and tender The skin of the lower posterior part is discolored and appears gangrenous This swelling extends to the penis and above about two inches along the perineal cord also involves the perineal region The prostate is slightly enlarged The white blood count is 29 800 The urine is filled with pus Temperature 98 pulse 98 The general condition is exceedingly poor He is in a muttering delirium Suprapubic cystostomy and wide drainage of infiltrated area Recovery

CASE 7 J A age 31 cook Admitted to Cook County Hospital May 26 1916 He complains of pain in the perineum frequency of urination with burning There is some pain with bowel movement and fever Two months ago the patient contracted gonorrhea and has had a discharge about six to seven weeks One week ago he began to have a frequency in urination eight or nine times daily and hourly at night with some burning A day or two later the swelling in his perineum between anus and scrotum began and it has been gradually enlarging until now including the tissues around the penis and his scrotum This region became red but not painful For two or three days he has had some pain when his bowels moved The pain he now has is dull in character and is localized to the area between anus and penis He has not passed any blood There is no history of injury He had fever for four or five days No chill He has vomited once His appetite is poor

Examination The scrotum is a tender braided firm swelling in the perineum between anus and base of penis and around anus The scrotum bright red There is no tenderness of testicles or epididymis There is marked tenderness and swelling of prostate and seminal vesicles Temperature 101 pulse 118

A member of the staff incised the perineal mass obtained urine and pus Condition rapidly progressed The following day mass was palpable just beside the right pubic spine beside the penis The penis was very oedematous the patient very toxic A small quantity of urine passed from the perineal sinus An incision over the above mentioned area revealed strong ammoniacal urine Suprapubic cystostomy and wide drainage of infiltrated areas

Recovery Much subsequent trouble in getting dilatation of strictures due to perineal fistula Ultimate complete recovery

The following classification can be made of the 31 cases of urinary extravasation from the urethra and bladder obtained from the records of the Cook County Hospital during the past four years

Extravasation of clean urine due to traumatic rupture 5 cases 3 deaths 2 recoveries 60 per cent mortality

Extravasation of septic urine due to traumatic rupture 4 cases 1 death 3 recoveries 25 percent mortality

Extravasation of septic urine due to old occluded fistula 2 cases no death 2 recoveries

Extravasation of septic urine due to inflammatory rupture 20 cases 7 deaths 13 recoveries 35 per cent mortality

CONCLUSIONS

In conclusion I should like to emphasize the following points

1 Extravasation of clean urine may present few signs early and not produce marked reaction for a period of time up to two to four weeks and then rapidly destroy life by sepsis

2 Urine in the presence of a stenosis of the urinary outlet is usually septic

3 Many cases of urinary extravasation are caused by a rupture of the urethra due to an inflammatory process which can be detected before perforation

4 Urinary extravasation must be treated according to the condition of the urine

a In clean urine cases closure of the perforation with drainage in case of necrosis is the method of treatment

b In septic urine cases suprapubic cystostomy with wide incisions in all infiltrated and oedematous areas rest to the urethra and subsequent careful dilatation of the strictures is the only safe method of procedure

BILE PERITONITIS WITHOUT EVIDENT PERFORATION OF THE BILIARY TRACT¹

By J J BUCHANAN M D FACS PITTSBURGH

EFFUSION of bile into the peritoneal cavity without evident rupture or perforation of the bile tract or alimentary canal has received serious consideration only within the last seven years

In a few previously recorded cases massive bile effusions have been found at autopsy when no evident lesion could be discovered. In all such cases however the clinical history pointed to a rupture and the parts were in such a pathological state that such a lesion could not be positively denied. A typical case of this kind occurred on August 11 1783

A fourteen year old boy fell from a mulberry tree and struck the ground face down. At noon on the same day he was admitted to Guy's Hospital London under the care of Doctor Saunders who bled him frequently (three times in the first 24 hours) purged him constantly and blistered his abdomen

Notwithstanding this treatment the boy was able to be up walking about the ward on the fifth day. His abdomen however began to enlarge and his general condition became progressively worse until the 24th day when he was tapped in the left lower quadrant and two gallons of yellow liquid evacuated which answered in every respect to bile. It was bitter became green on the addition of acids and when evaporated to dryness deliquesced with nitre

The fluid reaccumulated and he was again tapped on the thirty seventh day. This time the trocar perforated an intestine and the boy died of peritonitis five days later (six weeks after his accident)

The autopsy was performed by Mr Thomas Skeete² who reported the case at great length and with great accuracy in the *London Medical Journal* 185. He found in the abdomen between 2 and 3 gallons of dark bilious fluid confined by adhesions chiefly to the right side. The liver was removed from the body with a view to examine its under surface and to inquire particularly into the state of the gall bladder and biliary ducts. In consequence of adhesions to the stomach and neighboring parts nothing satisfactory with regard to the exact place at which the injury had been received could be ascertained

This is the earliest case which the writer has found of intraperitoneal bile effusion

without discoverable lesion of the bile tract or alimentary canal. There is no doubt in this case that a rupture had occurred probably of the common duct. The fact remains however that none could be found at autopsy with the specimens on the table

At the 1905 meeting of the American Surgical Association Dr Maurice H Richardson³ in a general discussion of diseases of the bile tract stated that in one instance he had found the right upper quadrant flooded with bile which had escaped from a gall bladder that was apparently normal. Drainage was successful. This is the first suggestion that the writer has found that bile may pass through an apparently normal gall bladder. Further particulars of this case regarding the examination of the cystic and common duct and duodenum do not seem to be on record. It is to be supposed however that an operator of Dr Richardson's skill and experience would undoubtedly have made careful examination of these parts

Five years later namely in 1910 Clairmont and von Haberer⁴ assistants of von Eiselsberg of Vienna reported the case of a patient on whom they had operated on February 10 of that year evacuating from the peritoneal sac an estimated quantity of 7 or 8 litres of a liquid that had all the gross characteristics of bile. Careful search at both operation and autopsy failed to reveal any perforation of the gall bladder or bile ducts or of the stomach or duodenum or any spot which could be suspected to be such. The patient was a 64 year old man with jaundice from obstruction of the common duct with a large stone. Owing to the unexpected condition found at operation no chemical examination of the liquid was made to establish positively its biliary nature. However neither then nor thereafter did the operators express any doubt that the effusion was bile

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It so happened that prior to this time Clairmont and von Haberer had made experimental ligation of the common duct in dogs to note the effect of this procedure on the excretion of urine. In 4 of their dogs the occlusion of the common duct had caused death with intraperitoneal bile effusion without perforation of the bile tract.

These animal experiments taken in connection with the operative and postmortem findings in their patient convinced them that they had discovered a previously unnoticed complication of obstruction of the common duct namely *a permeability of some part of the bile tract which being in a pathological state permits the transudation of bile into the peritoneal sac by a process of filtration when no gross perforation exists*.

Since the publication of Clairmont and von Haberer's paper 15 additional cases have been published 7 in Germany 4 in France and 1 each in Italy Switzerland Sweden and America. It has been assumed by nearly all of those who have reported these cases that the effusion of bile usually massive permeated the wall of the bile tract by a process of filtration without any gross defect according to the theory of Clairmont and von Haberer. This assumption however has been vigorously opposed by a number of authors who explain the pathological process in various other ways and by some who question the biliary nature of the effusion itself.

A critical examination of the cases reported shows such a lack of uniformity in the symptoms and course of the disease in the condition of the bile tract as shown at operation autopsy and by examination of specimens and in the apparent causes of the changes present that it must be concluded that the bile effusion in these cases is not the result of any definite pathological process.

Before making an analysis of the reported cases it may be well to give a brief history of the personal case which directed the writer's attention to this subject.

The patient a boy 12 years of age admitted to the Mercy Hospital Pittsburgh February 6 1916 with the following history. When 2 years old he had typhoid fever which confined him to bed for

12 weeks and from which he made a good recovery at 3 years he had whooping cough at 4 years scarlet fever with enlarged cervical glands at 5 years dysentery with vomiting severe abdominal pain and bloody mucous passages. This illness lasted 10 days. For the next 2 years he was never well was weak and thin all days tired could not go upstairs without assistance. At the age of 7 years he had adenoids removed.

In his eighth year he began to have attacks of abdominal cramp with vomiting of bile. Most of the pain was in the right upper quadrant. He was never jaundiced. Tenderness over the gall bladder was usually marked. His attacks usually lasted 10 days and were so severe that the neighbors would say "Jo is having one of his spells again." During his eighth and ninth years he had about a dozen such attacks but for the last three years he has had only four attacks.

Ten days before his admission he was in a rather rough game in which larger boys piled on him as he lay on the ground. That evening he came home sick with what proved to be an attack of tonillitis. In 4 or 5 days he was apparently well and returned to school. Ten days before his admission he was taken with colic at school and had to be assisted home. The abdominal cramps were attended by nausea and vomiting with slow pulse and but slight elevation of temperature.

The family physician was called and found that practically all of the patient's early pain and tenderness was high up on the right side of his abdomen. At the end of 48 hours the patient was still vomiting and his pulse was quite rapid. His abdomen was markedly distended and rigid. It was the opinion of the physician who had seen him in former attacks that notwithstanding the patient's youth the trouble was located in the gall bladder.

Condition on admission: Patient has the appearance of being seriously ill. Pulse is rapid and temperature but little above 100. Abdomen is markedly distended and erythematous. There is a uterine tenderness at McBurney's point and moderate sore over the whole abdomen. A diagnosis of diffuse appendicitis peritonitis was made and immediate operation performed.

Postoperative condition: Peritoneal cavity containing a mixture which seemed to be about half bile and half exudate. This gushed out as the abdominal wall was opened and filled the floor before a basin could be brought. The intestines were injected with a cocaine solution. The appendix was found dead but not mottled. The other intestines were normal. The neighborhood of the appendix was edematous. The patient's condition improved. The abdominal wall of the incision was black and appeared totally gangrenous. Gall bladder tenesmus filled the gallbladder and mucous passages. Common bile patent. Cystic ducts unobstructed. No perforation before dissection of bile tract. Duodenum almost normal.

point suspicious of perforation by reason of adhesions or plastic lymph

Mechanics of operation Incision at margin of right rectus for exposure of appendix which was delivered and removed. Incision was freely extended upward to give complete exposure of the bile tract. The gall bladder cystic and common ducts as well as the stomach and duodenum were carefully examined for perforation with negative result. The common duct was exposed by incising the oedematous peritoneum over it and it was found to be black and apparently gangrenous. It was opened and explored by passing a uterine probe into the duodenum and into each hepatic duct. All ducts were found free from obstruction by stone or otherwise. The mucous membrane of the common duct as well as its wall was black and appeared to be in a state of gangrene. This condition of the common duct has a parallel in those unusual cases in which the gall bladder wall is deeply congested its mucous membrane black and which for one reason or another are treated by drainage and recover without sloughing.

A rubber drain was passed into the hepatic duct and anchored with catgut suture to the common duct whose opening was closed snugly around it. The gall bladder was opened and found to be free from calculi. The margin of the opening was overwhipped and the gall bladder was drained with a rubber tube. Fresh bile soon began to drain from both gall bladder and common duct. The region of the common duct was protected by two cigarette drains and a rubber tube the peritoneal cavity was mopped out to remove the bile and exudate that remained and the abdomen was closed without drainage except as stated.

Subsequent course The peritonitis subsided at once and the patient made a good recovery retaining a biliary fistula with variable flow for about six months. This was regarded as a favorable factor considering the previous history of the boy and the marked condition of his bile tract found at operation. At the end of 6 months the fistula spontaneously closed and the boy has since remained well.

I or a boy to suffer from his eighth to his twelfth year with repeated attacks which in an adult would be considered biliary colic is unusual. The operative findings however confirmed this diagnosis which had been positively held by his medical attendant. The clear history of a severe typhoid fever when the boy was but 2¹ years old is very pertinent in this connection. It is unfortunate that cultures were not made of the contents of the gall bladder to determine the presence or absence of the bacillus typhosus. A postperitoneal traumatic rupture of the

common or hepatic duct with infiltration of bile and subsequent infection of the effusion by organisms from the infected tonsils is a strong possibility.

There are two questions however of paramount importance in the interpretation of this case. First was this really bile that gushed in such a flood from the peritoneal cavity and secondly if so how did it get there? We may be better able to answer these questions after consideration of the facts brought out concerning similar and cognate cases hitherto reported.

Cases have been considered eligible for listing in the appended table only when the gall bladder cystic and common ducts stomach and duodenum have been satisfactorily examined at operation or autopsy or both.

Nauwerck and Luebke¹ as well as Sick and Fraenkel² would go much farther and exclude all cases that had not come to autopsy and had the gall bladder examined microscopically by serial sections. This seems to be an unreasonable requirement.

REACTION OF THE PERITONEUM TO EFFUSED BILE AND POSSIBILITY OF SPONTANEOUS CLOSURE OF PERFORATION

The reaction of the peritoneum to the presence of effused bile depends on whether the bile is sterile or infected. Infected bile of course causes a peritonitis virulent in proportion to the activity of the bacterial content. Sterile bile on the other hand is well tolerated. Experiments made in 1903 by Fraenkel and Krause³ showed that opening of the gall bladder by means of laparotomy in guinea pigs and rabbits under aseptic precautions did not injure the health of the animals in the slightest degree. If one kills such an animal after some time one is convinced that the unsutured wound has cicatrized with partial obliteration of the gall bladder and with adhesions to the surrounding tissues.

Clinical cases are by no means lacking to show that bile even in enormous quantity may be well tolerated by the peritoneum and

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that spontaneous closure of a traumatic lesion of the bile tract may occur after repeated tapplings and be followed by recovery

Mr Fryer in 1813 reported the case of a boy of 13 who had received a violent blow over the liver by the haft of a cat on June 803. Eleven days later he was jaundiced and had a holic stools. Three weeks after the accident he was tapped and 11 pints of pure bile drawn off. On the thirty third day he was again tapped and 5 1/2 pints of bile withdrawn. On the forty second day, 6 pints were removed. Complete recovery followed and he is known to be well 10 years later.

Mr William Robert Barlow in 844 reported the case of a man who had had a probable rupture of the common duct from lifting a heavy ladder. He developed a localized swelling in the right hypochondrium and was tapped at the end of 6 weeks and quarts of pure bile drawn off. Thereafter he was tapped successively on the fifty fourth, fifty fourth, seventy third, eighty first and ninety first days; the total amount of bile removed being 3 quarts averaging more than 10 ounces a day for the whole period. No bile passed into the intestine during the entire 13 weeks. The man made a complete recovery in five months.

Bargellini in 189 reported the case of a young man who fell against a drinking fountain striking on his hepatic region. He was ill for 10 days and then returned to work. Three and a half months after the injury his abdomen was found to be full of liquid. He was tapped and ten litres of a dense liquid of a intense ochre yellow color almost exactly identical with bile was removed. The patient recovered without further tapping.

On the other hand the rupture of the bile tract may not close and still the bile effused may for a long time be tolerated by the peritoneum.

Labrosse a pupil of Jaboulay of Lyon in his inaugural thesis of 19 reported the case of a young man of 17 years who two years before had fallen from a ladder onto a wall striking on the right hypochondrium. Light or ten days later his abdomen began to enlarge and so continued till he came under Jaboulay's care. The abdomen was opened and there flowed out 8 to 10 litres of bile. A small perforation was found in the gall bladder which must have existed for two years and the peritoneum was thickened and covered with false membrane. The patient died two months later of secondary infection through the drainage opening.

case of Ratjen (abstracted by Sick and Fraenkel) 6

The patient was a 15 year old boy who had sustained no severe injury or external trauma. He had however a continually increasing effusion of bile into the peritoneal cavity as could be known by a constantly increasing circumference of the body which necessitated repeated puncture. The patient finally recovered with an open perforation.

Nature of the effusion. An examination of the table will show that in not a single instance in which the abdomen was opened during life was a chemical examination of the liquid made to prove that it was bile.

During the operation it does not seem to have occurred to any of these surgeons that the effusion could be anything else than bile. In only one of the cases in the list was bile pigment demonstrated by chemical examination that of Brugnattelli. In this case aspiration of the liquid was twice practiced and the patient died. This case is not without suspicion of rupture having been caused by injury and exhibiting at autopsy a fibrinous peritonitis. The report of the autopsy states that all the abdominal organs were entirely or partly covered with plastic lymph. Under these circumstances an unrecognized perforation might easily have existed.

The only other case in which a chemical examination of the effusion was made was that of Salager and Roques. The patient died without operation and an examination of a small quantity of the liquid by Pettenkofer's test was negative.

If therefore a chemical examination of the effused liquid is made a condition for the acceptance of this pathological picture then the whole case of a bile peritonitis without perforation falls to the ground.

On the other hand it seems unlikely that such a considerable number of observers many of them known to be skillful and experienced should be mistaken in the recognition of a liquid so characteristic as bile.

This matter remains in doubt. In two reported cases those of Schievelbein⁸ and Johannson⁹ the authors found

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greenish bile in the gall bladder and clear yellow effusion in the abdomen and strangely enough this has been held to be a proof that the liquid was changed in color and consistency by filtering through the gall bladder wall.

If some or all of these effusions are not bile to what may their color be ascribed? The bilious hue of the ascitic fluid in jaundiced patients is a matter of common knowledge and still this fluid is not bile. Mr Thomas Skeete¹ pointed out this distinction in 1785 in the report of his case above noted.

Saffron yellow peritoneal effusions are occasionally seen by all surgeons when necrotic tissue is present such as a gangrenous gall bladder or an appendix. These effusions have been subjected to chemical analysis by various surgeons and pathologists notably by Davis³ of Philadelphia and Roger and Derrien² who have found the color to be due to pigments derived from the blood. Askanazy⁴ of Geneva also has evolved what he calls the law of the pigmentophilic of necrotic tissue which enables it to seize coloring matters and then to spread them

Anyone who is disposed to be at all critical and to doubt the existence of a bile peritonitis without perforation can find reasonable grounds for disputing the case of Clairmont and von Hüberer because of the general icterus and the cases of Schiesselbein⁶ Favreul⁶ Salger and Roques⁷ Madlener⁸ and Leriche and Cremieu⁹ because of the presence of incipient or complete gangrene of the gall bladder.

Condition of the bile tract It is very interesting to notice that inflammatory or carcinomatous lesions or stones were present in 13 of the cases in the table and of the other 3 were cases following trauma and in 1 typhoid ulceration was probably present the bile in pure culture being found in the effused liquid. Stone was present in 7 cases.

obstruction of the common duct in 4 cases
and cholecystitis in 10 cases

In 81 per cent of these cases therefore there was undoubtedly a pathological condition of the gall bladder or bile ducts and this in itself would to a certain extent support the observers in their assumption that the effused liquid was bile.

Bacteriological examination of the effusion
Bacteriological examination here is less important than chemical. It was made of the fluid found at autopsy in one case (Clairmont and von Haberer) cocci in pairs and short chains being found of the fluid found at operation in one case (Doberauer) bacillus typhosus being in pure culture, it was negative in 2 cases (Schievelbein, Nauwerck and Luebke) in the other cases no culture was made or the subject was not mentioned.

There are a number of possible channels for escape of the effusion into the peritoneal cavity.

1. *Filtration through the wall of the gall bladder or bile ducts rendered abnormal by disease or injury.* This theory originally proposed by Clairmont and von Haberer has received the support of 17 out of 19 who have reported cases or written at length on the subject Schiesselbein and also Askanazy summoned to the support of this theory the canals of Luschka while Sven Johansson found in his case a great dilatation of the lymphatic vessels and considered this an element in the so called filtration process.

No doubt the great majority of surgeons if called on to express an opinion as to the likelihood of such a process would be disposed on general principles to deny the probability of the filtration of bile through the unperforated wall of the gall bladder or bile ducts such a process being contrary to all experience in these or other hollow organs of the abdomen. They would consider that an undiscovered opening existed or that the liquid was not a true bile or bile mixture.

At the same time there are a few cases which are very difficult to explain without accepting the filtration theory namely those of Gibbon¹⁰ Johansson¹¹ and Guibe.¹

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2 *Microscopic perforation* A perforation so small as to be detected only by the microscope and so devious in its course as to be found only by serial sections would seem to have very little claim to be the channel of escape for enough bile to fill the abdomen. Such however is the claim in the case of Nauwerck and Luebke. This theory of a devious microscopic perforation is rendered less probable by the fact that the contents of the gall bladder contained colon bacilli while the peritoneal bile effusion was sterile.

3 *Small perforation hardly visible to the naked eye* Sick and Fraenkel¹ in 1913 reported the case of a 32 year old man who the day after a slight injury of doubtful import had severe peritonitic symptoms. On the fourth day he was opened. The abdomen contained a great quantity of clear yellow bile. A small opening was found in the gall bladder about as large as the puncture of an hypodermic needle. From this opening clear bile was exuding in little drops. Elsewhere the bile tract was normal. The gall bladder was excised and found to be normal except for this opening which just sufficed for the passage of a bristle diagonally. This case while not coming within the scope of the present inquiry has a very decided bearing on another possible explanation for these cases namely

4 *Rupture subsequently healed* leaving an unabsorbed effusion. This is a possibility which should not be overlooked for such an occurrence has been frequently observed and a number of such cases are referred to in the earlier part of the present paper.

It should not be forgotten however that in these cases the opening is probably always closed by adhesions to other organs and especially to the omentum. This is the method of closure observed in experimental cases and is the normal way of cure in perforations of all the hollow organs of the abdomen.

In the cases under consideration and here tabulated no such adhesions exist which makes this explanation improbable to say the least. Another possibility remains namely that the adhesions have subsequently pulled loose which also is unlikely.

5 *Rupture of an intrahepatic bile canal* In 1905 Nauwerck² exhibited at the Medical Society of Chemnitz the specimens of two patients jaundiced from stone obstruction of the common duct. Each of these specimens showed dilatation of the subserous bile canals on the surface of the liver and a rupture of one of these canals in one case slit like and in the other almost as large as the head of a pin.

In 1909 Karillon³ one of Nauwerck's students reported 2 additional cases of the same nature. Nauwerck and Luebke in 1913 reported a fifth case with 1200 c c of almost pure bile in the peritoneal cavity with a subserous bile canal showing a rupture the size of the head of a pin.

In the same year Vogel⁴ of Vienna reported a similar case. Five additional cases have been reported but in every one of these cases there was obstruction of the common duct by cancer or stone. In not one of them was the patient operated on and the discovery of such a condition at operation is probably impossible.

As an explanation of two cases under consideration this condition is considered possible but in the highest degree improbable.

6 *Postperitoneal rupture or perforation of the common or hepatic duct by trauma or ulceration* followed by bile effusion into the postperitoneal tissue and subsequent rupture into the peritoneal cavity at a point more or less removed from the site of the perforated bile passage. This method for the escape of bile into the peritoneal cavity has not been suggested by previous writers on this subject.

Postperitoneal effusion of bile from rupture or ulceration of the common or one of the hepatic ducts is one of the rarely recorded pathological conditions. An early and very typical case of this kind is that of Mr. Thomas Wainwright⁵ of Dudley, England reported in 1799.

The patient fell from his horse and received a violent blow in the epigastrium which caused profound shock and unconsciousness. The following day the epigastrium was swollen, tense, discolored and very tender. For several days the skin con-

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junctivæ and urine were tinged with bile. The pain was constant and very acute and after some time extended gradually down the right side to the bottom of the belly and from thence to the left side the abdomen was now tumid and an obscure fluctuation was felt. Eight weeks after the accident the patient died.

The autopsy was most interesting and evidently conducted with the greatest care. The bile had apparently escaped from a subserous rupture of the hepatic duct where for a space two inches in diameter the peritoneum was lifted and formed part of the sac wall. From its origin at the inferior surface of the liver the sac was traced under the diaphragm the fluid contained having dissected the pleura from the ribs and formed a tumor which compressed the right lung, thence descending in the reverse course of the ascending colon and pushing the caput coli obliquely inward the sac passed into and completely filled the pelvis pressing the urinary bladder into a very contracted space. Ascending from the pelvis the sac followed the reverse course of the sigmoid flexure of the colon to the diaphragm where it terminated. The right and left divisions of the sac communicated only in the pelvis the spine forming a barrier between them. The sac held three or four gallons (by computation) of a grass green colored fluid which was evidently mixed largely with bile.

A plastic peritonitis was present but no bile was found in the peritoneal cavity notwithstanding the extensive subserous dissection the long standing of the condition and the tension of the enormous quantity of bile contained in the subserous sac.

That an undoubted postperitoneal rupture of some part of the bile tract may occur and elude a careful search for it at autopsy is shown by a case reported by Routier¹ in 1910.

In June 1901 he performed a cholecystectomy for stone in the cystic duct and gall bladder. The patient recovered and returned to her work. She later returned with a very deep right sided extra-peritoneal abscess. This Routier evacuated and drained. The next day bile began to drain from the tube and flowed in abundance till the patient's death four days later.

He reports that at the autopsy it was impossible for us to find the place from which the bile had escaped which had filled the drained cavity. There had been an infiltration of bile all along the vertebral column we discovered the integrity of the acinar resulting from the former cholecystectomy and we found a calculus with facets obstructing the ampulla of Vater and a small stone ramifying in the right branch of the hepatic duct. The common duct was a little dilated but the rest of the intra-hepatic bile tract appeared to be normal.

Interpretation of author's case. Return ing to the questions propounded above concerning the author's case it may be said that he is still convinced that the liquid effusion was a bile mixture and that taking all the facts into consideration the most probable channel of its escape is the one last considered.

The history of previous attacks of cramp in a young boy always considered biliary colic acute almost gangrenous cholecystitis and cholangitis as demonstrated at operation history of an injury such as might cause a bursting rupture of a gall tract intense œdema of the ascending mesocolon and the postperitoneal cellular tissue abundant bile effusion prompt subsidence of all symptoms by free drainage of the bile tracts taken together seem to make a picture explained only on the hypothesis of a postperitoneal rupture of a bile tract with secondary rupture into the peritoneal cavity.

TREATMENT

The conditions present in the recorded cases being so varied no valuable conclusions can be drawn from the results of the different methods of treatment. It may be stated however that the gall bladder was drained in 5 cases with 3 recoveries and 2 deaths the gall bladder was removed in 4 cases with 3 recoveries and 1 death the hilum of the liver was tamponed in 3 cases with 1 recovery and 2 deaths the pelvis was drained in 2 cases both fatal aspiration was practiced in 1 fatal case and another patient died without operation. The general mortality therefore was 56 per cent.

Of the 14 cases operated on in 6 the bile tract was drained with a mortality of $33\frac{1}{3}$ per cent in 8 the bile tract was not drained and in them the mortality was 62.5 per cent.

Leaving out of consideration the results of the recorded cases it would seem to be wise when there is a peritoneal cavity flooded with bile from an undiscovered place of exit to dry mop the cavity and drain the common duct treating the gall bladder as its condition requires. The chief indication is to prevent further effusion by tapping the great bile canal.

CONCLUSIONS

1 There is no typical disease picture to account for a bile peritonitis without evident perforation of the bile tract

2 There is a group of recorded cases with abundant effusion in which no perforation could be demonstrated at operation or autopsy

3 These cases may be accounted for in a variety of ways some fitting one hypothesis and some another no one theory suiting all cases

4 The bilious nature of the effusion still

lacks the proof of a chemical examination It is to be hoped that subsequent cases may be subjected to the test for bile acids and bile salts

5 The cases being so unusual and so atypical the diagnosis has not yet been made even tentatively the real condition having never been even suspected in any of the published cases

6 The treatment should be dry mopping of the peritoneal cavity and direct drainage of the common duct

CLINICAL STUDY OF BLOOD PRESSURE AND HÆMOGLOBIN IN POST OPERATIVE SHOCK POSTOPERATIVE HÆMORRHAGE AND POSTOPERATIVE CARDIAC DILATATION¹

By JOHN OSBORN IOLAK M.S. M.D. F.A.C.S. AND OTTO H. HEFFTER M.D. BROOKLYN

OCCASIONALLY there is considerable difficulty in making the differential diagnosis between postoperative shock and concealed intra abdominal hæmorrhage. The clinical picture in many cases is so identical that even the most experienced may err unless proper recognition is given to the changes in the composition of the blood which take place in these two conditions which may be shown in the hæmaglobin percentage and red and white cell count together with the comparative blood pressure readings

At the Long Island College Hospital during the past two years we have been making a series of clinical observations upon the relation and clinical importance of blood pressure pulse pressure hæmaglobin percentage and leucocyte changes in post operative shock and hæmorrhage and in postoperative cardiac dilatation. The object of this study has been an attempt to correlate the value of laboratory findings as an aid in making a differential diagnosis in shock hæmorrhage and cardiac dilatation the bedside diagnosis of which as I have said before is often confusing or indeed even impossible

A preliminary report of this work was offered before the section of Obstetrics and Gynecology of the New York Academy of

Medicine in November 1916 by my President Gynecologist Dr Otto H. Heffter. In this preliminary report the details of the procedure employed were carefully described. Our routine was as follows

Readings were taken on the day previous to operation. As soon as possible after operation a second reading was taken. Observations were repeated at convenient intervals for several days. Due to the fact that the work was carried on in conjunction with the routine and work of the hospital it was impossible to establish a definite schedule as to the time of making observations. Usually the first reading came within one hour following the operation and several subsequent readings were made within the first 24 hours. Further readings came at daily intervals of from 3 to 5 days. The blood pressure readings were taken with the mercury column sphygmomanometer by the auscultatory method. The hæmaglobin estimations were made with the Sahli apparatus. The standard Leitz Wetzler counting chamber and pipettes were used in making the blood counts. Blood smears were stained with Wright's polychrome solution.

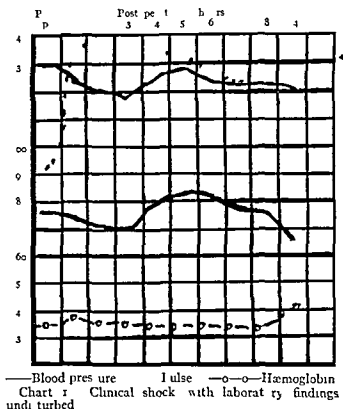
Therefore we will not take up your time in describing these details anew. We have to say that the pulse pressure was taken in the great majority of instances by the same man and the reliability of the data can therefore be vouched for.

From this study we have found first that

the pre operative index of the woman's cardiac strength is the pulse pressure. It makes no difference so far as the operative prognosis is concerned whether the systolic blood pressure is 105 or 160 so long as the diastolic pressure is not within 30 millimeters of the systolic. In other words provided the metabolism is near the normal the pulse pressure of the individual is the index of cardiac strength no matter what her systolic blood pressure may be. The only exception to this statement is the very high pulse pressure in aortic regurgitation. Second the hæmoglobin and leucocyte count are the next important factors for pre operative determination and third the blood coagulation time of the individual is of considerable significance as a pre operative consideration.

These observations together with a knowledge of the efficiency of the kidneys as shown by the usual functional tests are made as a pre operative routine. Their routine employment will give the woman her greatest margin of safety and afford the surgeon a basis for his differential diagnosis in post operative conditions. With these factors definitely known it is an easy matter in any given case to follow the postoperative course for the first 24 or 48 hours and by the further aid of the laboratory to be able to make a strong presumptive diagnosis as to the complicating postoperative condition.

In this study we will consider first what normally happens after an abdominal section with 30 to 80 minutes ether anesthesia. In this series of cases ether anesthesia by the open or closed method with preliminary morphine and atropine was employed. The average length of anesthesia was 75 minutes. The average amount used 5 ounces. It was found that there was a rise of 5 to 15 points in the hæmoglobin reading as taken from peripheral blood in 80 per cent of the cases studied which rise was directly proportionate to the length of anesthesia and the amount of anesthetic used. In 10 per cent of the cases the hæmoglobin reading remained unchanged. In one half of these cases however the length of the narcosis was considerably below the average for the series. The remaining 8 per cent showed a drop in the reading. These



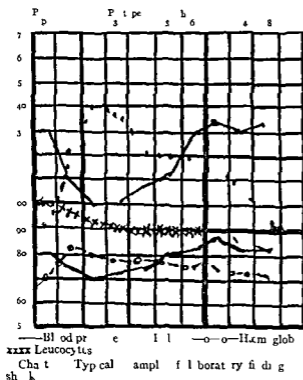
were cases of hysterectomy in which there was considerable blood loss.

Four cases remained unchanged with no apparent explanation. In endeavoring to account for the rise in hæmoglobin erythrocyte counts were taken with the readings. These remained fairly constant with only a variation ranging from one hundred to two hundred thousand cells which we feel is within the range of error. It was found that in 6 to 48 hours the hæmoglobin reading had practically returned to what it was previous to operation.

Routine blood pressures taken one hour after the operation showed an average systolic drop of 14 millimeters of mercury. The diastolic pressure showed an average fall of 7 millimeters.

In the majority of cases the blood pressure returned to normal in 4 to 4 hours following operation. Those cases which were distinctly shocked returned to normal on the second or third day postoperative.

The leucocyte count showed a rapid rise which was first noted one hour after operation and increased in six to twelve hours. The average rise by the sixth hour was 10,150 cells. Differential leucocyte counts gave a



relative increase of the polymorphonuclear cells their average rise being 14 per cent. The lymphocytes were accordingly reduced while transitional cells remained unchanged.

Now after establishing what occurred as normal phenomena following operation we considered the changes in a series of cases in which the patients were clinically shocked presenting the typical clinical picture of shock with the pinched pale face cyanotic lips shrunken eyes lusterless cornea dilated pupils reacting poorly to light cold and clammy extremities cyanosis of toes and finger tips diminished reflexes the general skin surface cold and clammy and bathed in a cold sweat. The respirations were superficial shallow and irregular the temperature normal or subnormal the pulse was weak rapid and occasionally very slow with a marked drop in the systolic pressure. Yet with the patient presenting such a picture the laboratory findings were negligible. Illustrative of this type is a case of carcinoma of the cervix in which a panhysterectomy was done.

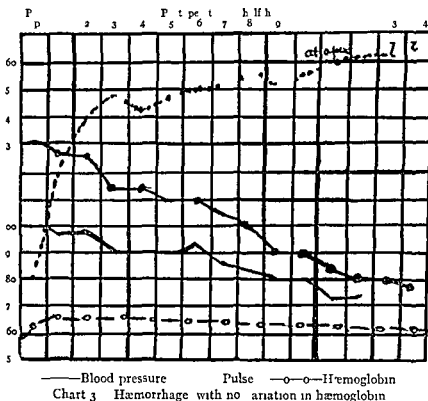
The patient went on the operating table with detailed pre operative laboratory findings. Her

pulse pressure was 50 and the hæmoglobin was 35 per cent. The blood showed agglutination and hæmolysis in the donor. The red cell count was 1 200 000 leucocytes 9 000 and the coagulation time 8 minutes. This patient was subjected to an operation lasting an hour and a quarter the greatest care being taken to avoid further loss of blood. She came off the table with a pulse of 130 small and compressible and with all the clinical symptoms of shock yet the laboratory picture showed that not only throughout the operation but during the first 24 hours after the pulse pressure was continuously maintained at 50 millimeters and the hæmoglobin showed no variation. Furthermore the red and white cell counts were not disturbed.

Another patient also suffering from malignant disease of the cervix was subjected to a radical operation which occupied nearly two hours. She was returned to her bed with a pulse of 158 and all the clinical signs of shock but not withstanding the laboratory picture showed her to have kept a constant pulse pressure of 50 throughout the first 24 hours of postoperative observation. The hæmoglobin leucocyte or red cell count in this case did not change from the readings of the pre operative records.

In the second group of cases while the patients presented the clinical phenomena of shock we had also a definite laboratory picture which differed so much from that found in the first group that had we not made a very careful and detailed study of these cases we would have conceded that the laboratory findings made the diagnosis. These cases showed a diminution in the systolic and pulse pressures with a rise in the hæmoglobin and red cell count. In illustration of this class another case may be cited.

A woman of small type had a series of plastics with removal of the upper segment of the uterus following the Bell Buettner technique. This patient had the usual full pre operative records. The red cell count was 4 200 000 the hæmoglobin 75 the leucocytes 8 000 with a blood pressure of 30 over 80. Following the operation we found that the hæmoglobin had risen to 85 and the red cells to 5 000 000 remaining high for the first 24 hours not reaching normal until the afternoon of the day following operation. The leucocytes dropped to 6 000. The blood pressure showed a drop of from 130 to 100 systolic over 80 diastolic. In other words the pulse pressure dropped from 50 to 30 as a result of the operation. This patient was given oxygen inhalations upon the withdrawal of the anæsthetic and reaction occurred 35 minutes later. With the reaction we noted an immediate rise in the blood pressure to 125 over 50. After the oxygen was



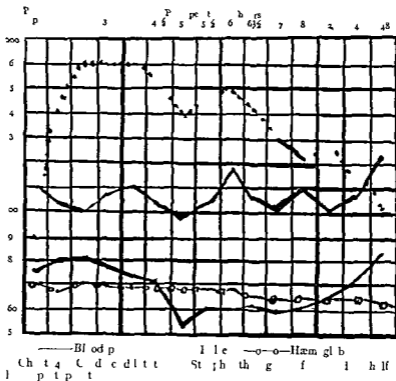
stopped the pressure again dropped to 110 over 78 and it was not until 48 hours after the operation that the normal ratio of 130 over 80 was re established

In our third group of cases we were dealing with shock and hemorrhage and we had supposed that with the aid of the hemoglobin estimation and repeated blood pressure readings we would be able to differentiate positively between shock and hemorrhage. We were however doomed to disappointment as clinical experience shows that unless the hemorrhage has been a frank hemorrhage the hemoglobin estimation and the red cell count show little change hence have little or no significance in determining the presence of slow bleeding. However the pulse pressure and an increasing leucocytosis will give valuable information. We know that in ectopic immediately following the rupture we have a drop in the hemoglobin a drop in the systolic and pulse pressure and an increase in the leucocyte count. This however is not true where slow bleeding takes place after operation. As you will see in the accompanying chart the hemoglobin percentage may not change even when bleeding is continuous. This patient had a pulse

pressure of only 10 yet the hemoglobin remained 65 per cent

Clinically but two facts stand out in the differentiation between shock and hemorrhage (1) in hemorrhage the pulse rate is always progressively increased (2) the leucocyte count is also increased

The striking similarity in the clinical manifestations of these two conditions is due to the fact that in hemorrhage the blood is permanently lost from the vessels while in shock it is accumulated in the large venous trunks of the splanchnic plexus and therefore is of as little use in maintaining the blood pressure as if the volume of blood was actually outside the body. This according to Crile is due to the exhaustion of the vasomotor center the cardiac and respiratory failures being secondary to the exhaustion of the vasomotor control. While Porter Mann Gatch and others accept the peripheral theory of shock it matters not with which side one aligns himself two facts must be accepted first that the visceral and peripheral arterioles are constricted and second that the veins and venous channels in the splanchnic area are dilated and contain the body fluid. In hemorrhage if it be of any con



siderable quantity one may always expect to find first a fall in the number of red cells per cubic millimeter second a decrease in the percentage of hæmoglobin and third an increase in the number of white cells with the maximum increase occurring early. In shock on the other hand the diminution in the red cell count does not occur but there is usually a reduction in the leucocyte count. When the bleeding occurs in the abdominal cavity which is the most frequent site of internal concealed hæmorrhage in women the two conditions vary only in the fact that in one (hæmorrhage) the blood is outside the vessels and in the other (shock) it is inside. In shock there is always a loss of the circulatory fluid due to the large quantity of blood which is cut out of the general circulation by the dilatation of the venous channels of the splanchnic plexus. The splanchnic vessels alone as is well known are capable of holding several times the total amount of blood in the body. In health there are two factors which prevent the filling of these vessels first the vaso-motor apparatus second the contraction of the abdominal muscles. The first acts by decreasing the amount of flow into the

splanchnic area while the contraction of the abdominal muscles raises the intra abdominal pressure and diminishes the capacity of the capillary and venous channels.

The flow through these vessels therefore depends upon the is a *tergo* of the heart assisted somewhat by the negative pressure in the thorax and by the rhythmic variations in the intra abdominal pressure resulting from the contraction of the abdominal muscles.

Analysis of the abdominal walls or laparotomy must reduce the intra abdominal pressure to that of the atmosphere and while the heart continues to fill these vessels there is no force to drive the blood out of them. Their capacity is greater than the entire volume of blood in the body and their walls have no external support. Hence the splanchnic vessels will become immensely distended and consequently the peripheral blood pressure will drop. This explains the value of posture and sand bag pressure on the abdomen in postoperative shock. Experiments on animals show that life is possible when intra abdominal pressure has been reduced to that of the atmosphere only when the return of blood to the heart is assisted by gravity and

when the animal is not required to make any great exertion. In the human abdominal incision causes a sharp decrease in abdominal pressure. Small incisions short anaesthesia and non eventration of the viscera minimize the splanchnic paralysis while large incisions protrusion and exposure of intestines are supposed to allow a marked stasis of blood to take place in the abdominal veins. This withdraws a dangerously large amount of fluid from the circulation hence shock is increased. Gatch has demonstrated that the deeper the anaesthesia the greater the accumulation of blood in the abdomen and legs consequently the blood pressure must be lowered. This is why operations in the Trendelenburg posture under light anaesthesia have less shock. When actual blood loss as occurs in haemorrhage is added to this intra abdominal stasis the loss in pulse pressure must be greater.

Pulse pressure readings taken during the operation have shown that traction on the mesenteries and exposure of the intestine to air increases the pulse rate and lowers the pressure. For exposure causes the intestine to become congested and blue in color and after prolonged handling it becomes oedematous and subperitoneal extravasation of blood occurs and the pulse is accelerated and the pulse pressure falls. The blood pressure falls because there is not enough fluid in circulation to maintain it. Morphine at this time changes this picture. In cardiac dilatation our studies show but one constant laboratory finding namely lowered pulse pressure. The clinical picture is unmistakable and needs no description before such an audience as this.

CONCLUSION

The deductions which one may draw from these studies are:

1. There is a constant rise of 5 to 15 points in the haemoglobin readings following anaesthesia with ether when such anaesthesia occupies more than 30 minutes. Consequently allowance must be made for this rise in using haemoglobin estimations as a diagnostic sign in internal bleeding.

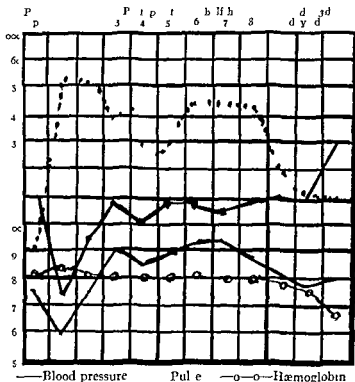


Chart 4 Shock with operative hemorrhage. One ampoule of strophanthin given intravenously four and one half hours postoperative.

The erythrocyte count is also increased but its variation from the preoperative is so slight that it does not warrant any conclusions.

3. In the majority of cases there is a moderate fall in both the systolic and diastolic blood pressure following ether anaesthesia. The blood pressure returns to normal that is to the preoperative reading in 12 to 48 hours. The inhalation of oxygen after the withdrawal of the ether vapor diminishes this fall in blood pressure but is only transient in its effect.

4. In cases of shock, especially where there has been much blood loss during the operation, the fall in blood pressure is greater than after long operation without blood loss, dropping from 10 to 50 millimeters.

5. The pulse pressure is a better index of hemorrhage or cardiac failure than the systolic pressure.

6. There is a constant rise in the leucocyte count in hemorrhage while the leucocytes fall in shock.

My thanks are extended to my resident Ott H. Hefster and my internes Doctors Shutter and C. Fry for their persistent and painstaking making of the laboratory findings in this series so complete as to allow me to draw these deductions.

CLINICAL AND EXPERIMENTAL STUDIES ON CONGENITAL PYLORIC STENOSIS¹

By RICHARD LEWISOHN, M.D., F.A.C.S., N. Y.

Assistant Professor of Surgery, Cornell University Medical College, New York City

STENOSIS of the pylorus in newborn babies is a borderline disease and its successful treatment needs the closest co-operation of the pediatric and the surgeon. Some pediatricists have claimed that in the vast majority of cases the disease can be cured without surgical interference. On the other hand, surgeons have made the statement that congenital pyloric stenosis is a purely surgical condition that medical treatment of the disease is not only without any value but decidedly harmful. Both these statements are erroneous.

The attempt has been made to divide this disease into two distinct groups: (1) pyloric spasm and (2) true hypertrophic pyloric stenosis. The opinion has been expressed frequently that the first group requires only medical treatment whereas the second group requires surgical intervention. Such a division of the disease into two groups is too didactic. Holt advises simply to divide the disease into mild and severe cases without making an actual anatomical distinction between the two groups is more in accordance with the clinical facts.

The cause of this disease is still a matter at birth with secondary edema in fact. Dent has observed a true pyloric stenosis in a seven months old infant which shows that the origin of the disease date back to the prenatal period.

The clinical symptoms of congenital pyloric stenosis are incessant vomiting, loss of

weight and constipation, palpable tumor and visible peristalsis. In a case presenting the above signs the presence of a pyloric tumor is pathognomonic of the disease. However, in many cases the pyloric tumor is not palpable. Visible peristalsis of the stomach, loss of weight and vomiting are sufficient clinical signs to establish the diagnosis.

We do not agree with the opinion expressed by some that all patients with congenital pyloric stenosis should be immediately operated upon. The pediatricist should try to cure the disease with proper diet, pareoric and other remedies. If all his endeavor are futile and no improvement is observed after a few days and if the baby continues to lose weight rapidly the case should be treated surgically without much delay.

Seventeen cases of congenital pyloric stenosis were admitted to Dr. Keplik Service at Mount Sinai Hospital during the last three years. Eight cases were treated medically and nine were transferred to the Surgical Department. Of the former eight cases, one died and seven were discharged from the hospital as improved or cured. The mortality among the nine cases operated on was much higher; five were cured and four died. The fact that the severe cases with marked emaciation were subjected to operation whereas the milder form of the disease were treated medically may explain the much higher mortality among the cases operated on.

Methods of operation. Until a few years ago gastric enterotomy represented the only surgical procedure for these cases. Since then the Rammstedt operation, published in 1913, has acquired great popularity. This operation consists of incising in a longitudinal direction the thickened and hardened pylorus through the circular and muscularis and down to the mucosa without perforating the mucosa (Fig. 1). The division of the constricted muscular ring effects the reestablishment of the pyloric

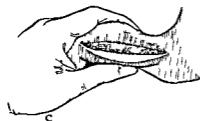


Fig. 1. Rammstedt's operation for congenital pyloric stenosis. The diagram shows a longitudinal incision through the pyloric ring, dividing the thickened muscularis and circularis layers, while preserving the mucosa.

lumen and a disappearance of the obstructive symptom

This new and very ingenious operation was generally adopted and extensively used by surgeons. Downes for instance has reported sixty six cases of pyloric stenosis operated on thirty five of which were operated on by the Rammstedt method. The mortality of his cases was 5 per cent. Gallie and Robertson have lately reported sixteen cases of Rammstedt operation with a mortality of 31 per cent.

Whether this Rammstedt operation will entirely supplant gastro enterostomy in the surgical treatment of congenital pyloric stenosis remains to be seen. The operation though it appears very simple and harmless is certainly not without danger. In order to effect a cure the thickened pylorus must be divided in its whole length and thickness. If the incision fails to divide the entire thickened area from stomach to duodenum if it is just a little too short a cure will not be effected. If this incision is made only 1 millimeter too long on the duodenal side there is grave danger of opening the duodenum which is especially thin in these cases. In other words the margin between what we must do to accomplish our object and what



Fig. 2. Rammstedt operation upon duodenum after operation.

we must avoid to prevent serious damage is such a narrow one that the operation cannot be regarded as free of risk or danger.

Experiments. The series of experiments upon dogs was performed in order to study the histological effects of the Rammstedt operation. Six specimens were examined microscopically. A period ranging between five and ninety one days had elapsed between the time of operation and the time of autopsy.



Fig. 3. Same. Figure 2 illustrates the incision.



Fig. 4. Baby 10 weeks after Rammstedt operation.

with hernia of the mucous membrane. Microscopic examination. There is a complete gap in the wall of the pylorus about 1 centimeter in width projecting through this is a fold of the mucosa which is covered throughout with fibrous submucosa. The cut ends of the musculature are attached to the submucosa at either side of the defect (Fig. 4).

The findings can be summarized in the following manner. Following an incision of the pylorus through serosa and musculature there is evidently a gaping wound produced which fills with blood clot to which the omentum becomes adherent. This clot is replaced by fibrous tissue which when it contracts brings the cut muscle ends into such close apposition that they may only be separated by millimeters. Regeneration of the smooth muscles does not seem to occur.

Of peculiar interest is the case in which there was an eversion of the mucosa and submucosa through the defect. As no mention of a similar occurrence can be found in the literature reason for its occurrence are only problematical. It is possible however that it may have occurred very shortly after the operation was completed due to a violent contraction of the pyloric musculature which may have forced a fold of mucosa and submucosa through the gaping wound. Fibrinous adhesion may then have fixed the raw submucosa to adjacent omentum (Fig. 4).

Case 5 of the series shown in chart 1 is sufficient interest to warrant a more detailed description. The baby was brought to the hospital with typical vomiting of pyloric stenosis. A Rammstedt operation



Fig. 6. Same baby nine months later.

failed to stop the vomiting. Therefore a second laparotomy was performed eighteen days after the primary operation. In the attempt to lengthen the original incision across the pylorus the duodenum was accidentally injured. The pinhole opening in the duodenal mucosa was closed with a double purse-string suture.¹ These sutures narrowed the lumen of the duodenum to such an extent that a gastroenterostomy was deemed necessary. The child died two days following the second operation.

A postmortem examination was performed and the stomach removed *intact*. The specimen showed very well why the vomiting had not stopped after the first operation. The Rammstedt incision though of sufficient length had not divided the musculature completely except in the very center of the incision (Fig. 5) where the mucosa was distinctly

The same day the type of the specimen was prepared for the purpose of the study.

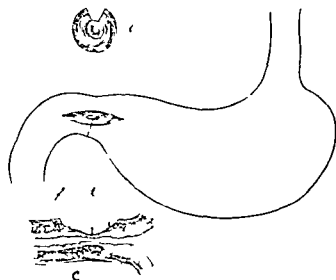


Fig. 5. Postmortem findings. Case 5. 1. Mucosa of the stomach in center of Rammstedt incision. 2. Cross section through the Rammstedt incision. 3. Detail of the stomach wall showing the Rammstedt incision.



Fig. 8. Cross section through the pyloric region (Fig. 7 d)



Fig. 9. Cross section through the pyloric region (Fig. 7 e)

merits of this operation. The number of our cases is too small to warrant any definite conclusion.

The operative mortality of 1.5 per cent among thirty-six gastro-enterostomized cases (combined statistics of Scudder, Stillman and Richter) compares favorably with

Downes' mortality of 5 per cent following the Rammstedt operation. It will require a much greater series of cases than heretofore published before it can be definitely decided whether the Rammstedt operation can really be considered as the method of choice or whether gastro-enterostomy, though less rapid



Fig. 10. Cross section through the pyloric region (Fig. 7 f)

in its execution might not give better clinical results

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FASCIA TRANSPLANTATION INTO LATERAL DEFECTS OF THE MAJOR ARTERIES

B HAROLD NICHOLS MD N Y N
I m i I m I m l C I l f h I

As a result of many investigations the great advantage of autogenous homotransplantation of tissue for the replacement of total defect of arteries has been definitely established. Up to the present the implantation of a section of an artery has been the best procedure for replacing an arterial defect in implantation is less desirable because thrombosis and occlusion are not infrequently observed. Similarly an arterial patch has been described by Carrel as the best method of substitution for lateral (subtotal) defect of arteries. Subsequently he investigated in two experiments theurgical possibilities in the use of a patch consisting of peritoneum and adjacent musculature. In one experiment a small part of the abdominal artery was replaced in the manner in the second a section a millimeter in length and a third of the aortic circumference in width was patched. Carrel reported that

the adaptation of the peritoneal patch to the aortic wall was so perfect that the vessels less than two years after the operation were absolutely normal. Although the new wall was composed of tissues different from normal the morphology of the aorta was not modified. Thus then is demonstrated that a small lateral defect in an artery can be satisfactorily replaced by a transplant other than a vessel wall but approximating arterial structure in the smooth peritoneal lining on one side and the attached muscle on the other

The purpose of the present communication is to demonstrate that fascia is as serviceable a vessel wall or peritoneum muscle for the replacement of even large lateral defects of the major arteries and at the same time offers greater possibilities for clinical application in the appropriate problem encountered in human surgery.

Except in the hands of a master of the technique of blood vessel surgery the simple end to end suture of a divided vessel results in failure in almost 50 per cent of the experimental attempts. The special technique required for the various steps of this operation is too well known to be detailed. In patching an arterial defect with a section of artery or vein or peritoneum muscle the same accurate apposition of intima of vessel to intima (or peritoneum) of transplant is essential avoidance of any trauma to the inner lining of the transplant is necessary special suture material must be used etc. In short the same



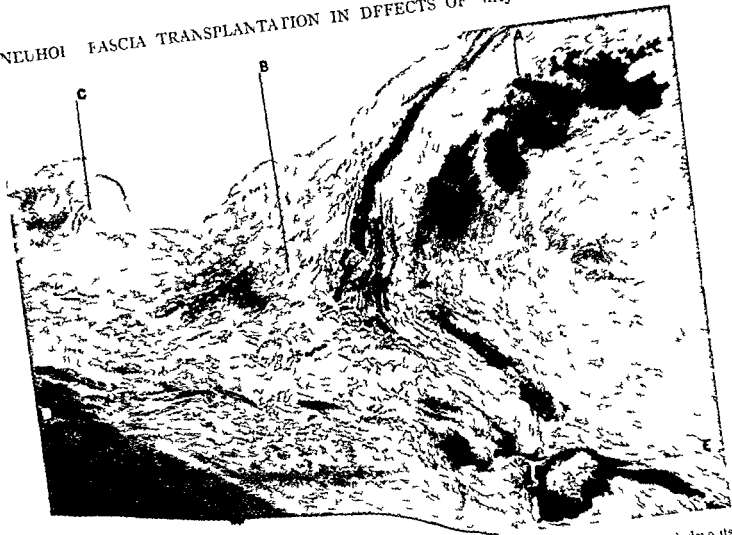


Fig. Micrograph of junction of transplant with the native artery. A Artery wall with deposits of fibrin. B C Old organized thrombus fusing the altered transplant. D Silk sutures.

puncturing technique as that for end to end suture of an artery must be carried out to insure any measure of success and the operation being more complicated (and the use of a transplant being involved) in even higher percentage of failures can be expected.

From the reports of microscopic examinations of transplants of vessels made by a number of observers it appeared to me that it was not imperative to employ like (artery vein) or even morphologically similar (peritoneum muscle) tissues adequately to replace lateral arterial defects. Indeed I believed that theoretically a simple strong connective tissue (fascia) would offer several advantages

for it could be used without fear of damaging a delicate intima without the necessity of accurate apposition of layers in other words without all the refinements of technique essential to the success of the other transplants. Apart from considerations of technique the chances for the success of a fascial graft appeared inherently greater than those of such (relatively) highly differentiated tissues as artery or peritoneum muscle. Finally I have shown that defects of other hollow viscera a ophagus trachea stomach bladder etc can be adequately replaced by fascia the tissues occupying the gap being permanently resistant and regeneration of the lining membrane and some other elements of the organ that had been bridged occurring regularly.

NEURO FASCIA TRANSPLANTATION IN EFFECTS OF MAJOR ARTERIES 325



It is clear that the surgical condition involving their use will be almost invariably emergency one encountered by the general and not the specially killed blood vessel surgeon. It is evident that autotransplant of piece of artery are not obtainable in human surgery and are therefore not to be considered. Vein graft are more feasible. To obtain them however a spiritus wound exposure may be required. Valuable time would be sacrificed for the careful dissection and proper preparation of the transplant (secondary hemorrhage and death followed in both in tortures in which they were used to patch the rupture) and the necessary ligation

of a large venous trunk is never desirable and by no means always harmless. The abdomen would not be opened merely to obtain peritonum musculum transplant. Their applicability would therefore be sharply limited to lateral defect of intra-abdominal vessel and a high incision would involve peculiar preparation and elaborate technique for their removal and successful transference. Autotransplants of fascia (aponeurosis) are accessible in the neighborhood of almost every operation wound. Fascia lata however because of its strength smoothness and even consistency is best suited for grafting. It is readily obtainable in a very few minutes in unlimited quantities for practical purposes and the removal of the portion required is harmless.

To determine if a fascia transplant can fulfill them the essential requirements for a



Fig. 4 A Seven months after transplantation of fascia into defect of the caudal artery. The patch lies between and so on the ruled scale.

Fig. 4 B Six months after fascial transplantation into

defect of the abdominal aorta. Patch lies between and so on the ruled scale.

Fig. 4 C Six months after fascial transplantation into defect of the femoral artery. Patch lies between and so on the ruled scale.

the graft for a lateral arterial defect must be considered. The transplant should not act as a foreign body. There must be the minimal possibility for the development of thrombosis and occlusion. If the graft does not remain viable the site of the defect must be occupied by a permanently resistant mass of connective tissue (preventing the possibility of aneurysmal dilatation) smoothly lined on its inner surface and not encroaching on the lumen of the vessel. The replacement of large defects must be feasible; for small ones can be closed by simple suture. To establish its clinical applicability the graft should be transplantable under unfavorable circumstances—in the presence of incomplete hemostasis of the artery receiving it—for large defects of the smaller arteries, for the thoracic aorta where pressure is high, and prolonged obstruction of the arterial current is not possible. Finally to repeat the technique and armamentarium involved in obtaining and implanting the graft must be simple to be universally applicable.

The results of the experiment to be reported show that all the requirements were fulfilled by the use of fascia transplant. Seven experiments were performed, all on dogs, of which four were followed for sufficiently long period (ix to nine months) to report the more permanent result. In only one fascia replacement of a large defect of the abdominal aorta involving almost the entire circumference did hemorrhage follow, and in this experiment total resection with tubularization by another vessel would have been a more logical procedure. The outcome was good practically but poor histologically, in the femoral artery thrombosis and

canalization in a small area having supervened. The results of all the other experiments were entirely satisfactory anatomically, functionally and histologically.

The technique of operation was very simple. Except for the addition of sterile technique and unusually fine sewing silk, no changes were made from the usual operating room asepsis and armamentarium of our animal laboratory.

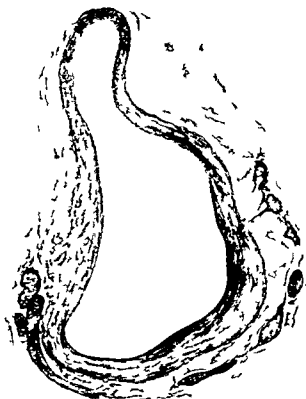


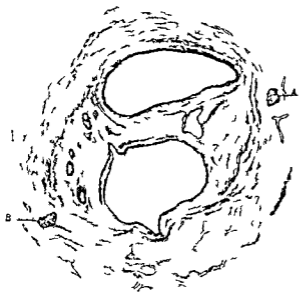
Fig. 5 A Six months after fascial transplantation into defect of the abdominal aorta. The patch lies between and so on the ruled scale.



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tory. Either by intratracheal insufflation was used for the operation on the thoracic aorta by the rebreathing method for the other experiments. The artery is exposed the portion from which the piece is to be taken is isolated it hemostasis is established by a rubber protected clamp at each end and the ligation or temporary clamping of branches of the artery between them. The desired section of the wall of the artery is then excised and the defect measured with a sterilized steel tape. Blood in the interior of the vessel is washed away and a gauze sponge freely spread with vaseline is placed over the exposed lumen. The fascia lata is then laid bare near the knee joint a section of the desired shape and of slightly larger size is measured off removed dipped in vaseline and immediately placed over the arterial defect with its smoother surface facing the lumen. It is fixed in place by four sutures and a continuous suture approximating edge of fascia to cut edge of artery is made between them. Compressing the patch lightly with a piece of

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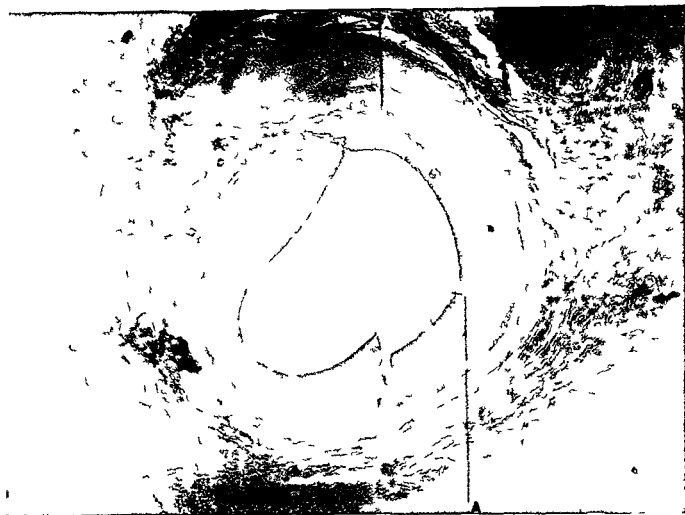


Fig. 9. Microphotograph of the transplanted section of the femoral artery immediately below the thrombosed area. The latter has ingested only one section a few millimeters in length. The elastic lamina of the artery indicates the arterial wall.

vasclined gauze the lower and then the upper clamp on the artery are removed. If there is oozing from gaps between individual stitches reinforcing ones are pressed from the margin of the transplant to the adjoining arterial wall at those places.

Experiment on thoracic aorta. Dog of average size. Intratracheal anesthesia. Operation May 17, 1916. Long incision in the seventh left intercostal space with removal of sections of the sixth and seventh ribs. After opening pleura the lung was packed away from the field of operation. The pleura over the descending thoracic aorta was incised and stripped off. The aorta was clamped off above and below. A section six centimeters was removed. There was some bleeding, although the intercostal vessels were clamped. Fascia was sutured into the defect. A reflected flap of pleura was sutured in place. There was no bleeding upon removal of the clamp. Normal pulsation. The thorax was closed with stab drain at the bottom of the pleural cavity.

The dog showed evidences of pneumothorax at the end of operation.

The latter cleared up in a few days. The drain was removed and the course thereafter uneventful. Chloroform was administered December 16, seven months after operation. There were filamentous adhesions between the surface of the lung and pericardium line of incision in chest wall and surface of transplant. When the latter was separated (which was very readily accomplished) the site of the transplant was represented by a smooth glistening surface bulging slightly above, not at all below. Normal pulsations of the segment containing the transplant and of the adjoining segments. The intercostal branches in the region operated upon bled freely. Upon measurement after removal the size of the patch was the same as when implanted. After fixation in formalin inspection of the inner surface showed smooth continuity with adjoining aortic lining below and abrupt demarcation between transplant and vessel intima above. The apparent aneurysmal dilatation of the patch is due to the contraction of the aortic wall and the noncontraction of

THE CARE OF THE PUERPERAL WOMAN, POLYPOID DECIDUAL ENDOMETRITIS

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G3 1 g t t h P e r t h H p t l

GENERAL INTRODUCTION

THE present war has more than ever demonstrated that the safety of a State depends ultimately on the number of healthy men it produces—patriotism and efficiency in their broadest sense are largely matters of education. Knowledge therefore which tends to diminish the morbidity or the mortality from childbirth or from abortion and which is thus intimately bound up with the wellbeing of womankind and therefore of the whole race should at the present stage in our history make an insistent demand on our attention. That this view is acceptable to the profession generally is evidenced by the reception extended to Professor Donald's article in the *British Medical Journal* on

The Care of the Pregnant Woman. But while we all may be agreed as to the upreme importance of conserving mother and child we may not all be equally agreed as to the special measures of protection. When this want of agreement involves the death of the mother and perhaps incidentally of the child it must argue lack of accurate knowledge on one side or on both or worse than all the application of ascertained scientific fact when the patient's fate is already sealed. In illustration let me recall a case seen in Perth some years ago. The twenty-three year old wife of a man who had led rather a wild life had been confined ten days earlier and was now in a condition of profound sepsis. The attending physician was confident that the placenta had come away absolutely perfect and that no membrane had been left behind. On passing my finger into the uterus I felt numerous firm polypoid elevations on the placental site but could not discover a particle of placenta or of membrane. I removed the polypoid outgrowth and explained that this was a case of *polypoid decidua endometritis*. The attending physician had barely heard of such a condition a

fact very unfortunate for his young patient as she continued to deteriorate and succumbed a few days later. This is but one of many such cases that have come under my observation.

When a case of puerperal septicæmia such as the foregoing arises in private midwifery practice all sorts of explanations are apt to be invoked such as the nurse or the surroundings or contagion or puerperal insanity while the medical attendant has perchance a vivid mental picture of the perfectly clean uterus drawn so convincingly in books but seen so seldom beyond their covers in puerperal septicæmia. In my experience in the Perth Hospital and elsewhere a septicæmia following on parturition and definitely associated with the interior of the uterus has rarely arisen apart from polypoid decidua endometritis. The objects of the present article are mainly to emphasize the high practical importance of polypoid decidua endometritis and to indicate the lines of successful treatment.



Fig. 1. Specimen of polypoid decidua endometritis from the Pathological Museum, Melbourne University. This is a specimen of puerperal septicæmia. The uterus has been removed and the specimen is shown in its entirety. The specimen is a dark, irregular mass with a lobulated surface, likely a specimen from a surgical or obstetric procedure.



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HISTORICAL AND ETIOLOGICAL

From a single case encountered at the postmortem table in 1861 Virchow invented the term polypoid decidual endometritis (*endometritis decidualis polyposa*) to indicate the naked eye pathology polypoid eminences being found studding the placental site. In this instance there was clear evidence of syphilis. As this was the first case in which polypoid decidual endometritis had been described the condition was naturally thought to be one of extreme rarity. The rarity of the condition however lies not in its occurrence but in its recognition for more recent investigations and notably those of Ahlfield and of Frank Nyulasy of Melbourne have demonstrated beyond doubt that far from being of extreme rarity polypoid decidual endometritis is relatively common and accounts for quite a high proportion of cases of adherent placenta and in that regard alone must be an efficient cause of much morbidity and of many deaths following on childbirth and abortion.

The relative frequency of polypoid decidual endometritis is not difficult to understand when it is borne in mind that probably not less than 10 to 1 per cent of the popula-

tion of large cities are tainted with syphilis and that syphilis in many cases at least plays an important part in the causation of polypoid decidual endometritis. In one of the most typical instances in my experience (seen with Dr Hicks) a very densely and universally adherent placenta was removed with the diseased decidua some hours after labor. There was a history of syphilis in the husband dating back somewhat over a year although the wife had shown no obvious external evidence of infection. The specimens sent to Dr Frank Nyulasy were such a striking example of syphilitic polypoid decidual endometritis that the incidental microphotographs were embodied in his thesis.

In the Melbourne University Pathological Museum there is a remarkably convincing collection of uteri affected with polypoid decidual endometritis (the women having all died of sepsis) and Professor Sir Harry Allen stated to me that he was satisfied that in a large proportion of the cases there was an underlying element of syphilis. The specimens had been provisionally labeled as instances of lumpy placental mark but following on Dr Frank Nyulasy's investiga-

tions they were classified as definite examples of polypoid decidual endometritis.

Although syphilis is a very important etiological factor in polypoid decidual endometritis it is quite possible that other organisms may be responsible in some cases. It would appear that the essential features of origin are (1) a low grade irritant (2) the irritant acting over a rather long period. It is thus not improbable that the gonococcus or the common pyogenic cocci may be set down as causes. In the Perth Hospital we have not commonly obtained a history of syphilis although in the sections examined the microscopic features have hardly been distinguishable from those with a definite syphilitic history.

MORBID ANATOMY—TWO TYPES

Polypoid decidual endometritis is a disease of the decidua which may or may not lead to abortion many of the most typical cases being met with after full time labor. It mainly affects the placental site but may extend down to the cervix uteri. In practice it usually presents itself in one of two types (1) as tough somewhat rounded *polypoid* eminences of various sizes (2) or as leathery *papillomatous* outgrowths.

Before I had come to properly recognize the papillomatous cases I had referred to them as examples of leathery placenta. Thus in an earlier paper (1908) in commenting on a case of perforated uterus the result of criminal abortion I stated that at autopsy a large amount of leathery placenta was still adherent although practically all the ordinary spongy placenta had been removed by the curette at operation. What remained could only be peeled off with difficulty even with the uterus laid open on the table. The microscope has invariably proved these cases of leathery placenta to be instances of polypoid decidual endometritis. As in the case just referred to the ordinary spongy placenta can be removed with no great difficulty. It is only when this has been done that the papillomatous character of the decidua becomes manifest.

With extensive and more evenly distributed growth of new fibrous tissue in

decidual endometritis it seems obvious that there may be little evidence of polypoid or of papillomatous outgrowths but merely a tough thick though probably uneven decidua.

A striking and most important feature of polypoid decidual endometritis is the marked tendency of the diseased decidua to undergo infective changes indeed Dr Frank Nyulasy believes that the great majority if not all of such cases will within some days present evidence of infection. In the *Transactions of the Australasian Medical Congress* of 1908 he describes polypoid decidual endometritis as follows. It is neither a hypertrophy nor an adenomatous condition as formerly taught but is a combination of chronic endometritis and metritis exaggerated by pregnancy and usually showing the signs of acute inflammation grafted upon the old chronic trouble as the result of sepsis. Striking features in microscopic sections are (1) endarteritis obliterans (2) very large venous sinuses (dilated capillaries) empty thrombosed or organized into fibrous tissue (3) fibrous tissue formation (4) actual decidual islands or decidual cells over fairly large areas separated by fibrous tissue (5) small cell infiltration (6) new formation of muscular elements projecting as ingrowths into the decidua (7) islands are seldom seen.

SYMPTOMS

The symptoms may be abortion adherent placenta or sepsis after the full time placenta has come away perfectly 'clean'. This latter fact is of the highest importance as in such circumstances the patient may die of blood poisoning just as effectively as if a large piece of placenta had been left behind. Not only this but in such a case septicæmia may come on without noticeable factor of the lochia. Furthermore before the actual onset of septic symptoms the patient may have been feeling well and showing no rise of pulse or of temperature when suddenly after some days there has been a rigor or a foul discharge or both.

Although the temperature pulse discharge and general condition are uncertain criteria of the presence of polypoid decidual endometritis the progress of involution of the

uterus is always to be depended upon. Thus the uterus may be found to be unduly large and the external os patulous perhaps admitting one or two fingers when it should have contracted down. The uterus should then at once be explored under anesthesia and any diseased decidua removed. If this is done in this early stage the patient will almost certainly recover if it is not done she may die of septicæmia.

TERMINI

Cases of abortion and those following on labor have usually been sent to the Perth Hospital because of the presence of sepsis or of hemorrhage. As to the proportion of cases of polypoid decidual endometritis we estimated some years ago that in a single series of 100 cases there were at least 80 per cent with adherent placenta. All the specimens of adherent placenta microscopically examined showed polypoid decidual endometritis. Altogether during about eight years in the Perth Hospital I have handled some 60 cases of the disease the cases being practically all drawn from the city poor. This suggests that syphilitic infection is rather common in Perth or that other organisms operate with frequency. Dr Frank Nyulasy gives the proportion of polypoid decidual endometritis as 3 to 5 per cent of all pregnancies. These figures indicate that it is a relatively common complication of pregnancy.

The treatment adopted has been *prompt removal of the diseased decidua*. I have invariably used the sharpest possible curette on the ground of its greater safety and greater efficiency. In some marked cases the curette alone will not suffice and the bare finger nail must be used in addition to positively dig out the diseased decidua. The uterus was in many cases then packed with iodoform gauze this being sometimes followed by intra uterine douching for some days. Dr Frank Nyulasy thinks highly of his large intra uterine iodoform bougies.

In connection with curettage it is to be noted that on account of the enormous venous sinuses in the diseased decidua of pronounced cases there may be severe hemorrhage. Indeed in occasional instances I

have felt constrained before the curettage was complete to pack the uterus with iodoform gauze and subject the patient to a second sitting a few days later. Apart from hemorrhage however more than one sitting may be essential in odd cases. Thus in a five months abortion with a universally adherent placenta the papillomatous decidua was very difficult to remove my sharpest curette and finger nail proving only partially effective after prolonged effort. At a second sitting a few days later when the temperature and pulse had risen and the cervical canal contracted I did an anterior vaginal metrotomy to facilitate removal of the decidua remaining and even then was ultimately forced to assist the curette with forceps to positively tear away what still remained. The patient made an easy recovery.

In two of the cases in the recent series reported in this article the patient's condition was so poor and the hemorrhage at operation so profuse that a portion of the diseased decidua had to be left behind. The uterus was subsequently douched out twice daily for a week or two the patients recovering without further operative interference. It would appear then that in some cases at least the vascular connection between the uterus and the diseased decidua is so good that a certain amount of the decidua may be left and that the shreds brought away in subsequent douchings probably represent the necrosis of the outlying portions of the papillomata.

Proceeding on the lines indicated I have lost no case of polypoid decidual endometritis in the Perth Hospital (or in private practice) unless pronounced septicæmia was already present and the death warrant of the patient practically signed before coming under observation.

SEVEN RECENT CASES

A series of 7 cases of puerperal septicæmia (following on full time labor) was admitted to the Perth Hospital during a recent three months my house surgeon Dr Ward supplying the excellent notes from which the following observations are taken.

There was only one instance of true polypoid outgrowths and in this case there was not the slightest evidence of any adherent placenta. In all the other cases there was adherent placenta and it was only when this had been got away that the papillomatous decidua was revealed the growths being extremely tough and leathery and removed with difficulty. In some of the cases when the diseased decidua had been removed it was noted that the underlying uterine surface was very firm and tough as if infiltrated with fibrous tissue. All the cases were admitted critically ill with a history of rigors the pulse rates ranging from 120 to 140 vaginal discharge being unpleasant (except in the true polypoid case without any adherent placenta) the uteri large and soft and the external os patulous. In addition to removal of the decidua and daily intra uterine douching polyvalent antistreptococcal serum was freely employed and appeared to have value while transfer to the open air was effected as soon as practicable. Otherwise the treatment was symptomatic. Among the cases which recovered there were two instances of femoral thrombosis one of submucous fibroid which was spontaneously expelled in another case an acute nephritis (adema stupor albuminuria hematuria) was superimposed on a chronic condition while in another case an empyema developed and was successfully drained.

In one of the two fatal cases the abdomen was opened three weeks after delivery (a

week after removal of placenta and decidua) on account of severe pain and tenderness, the septic process had extended directly through the posterior uterine wall but hysterectomy was inadmissible. In the other fatal case the patient was admitted a month after labor in a critical condition with a history of rigors a few days before admission in spite of treatment she progressively deteriorated becoming drowsy and delirious with choreiform movements, no autopsy was held.

GENERAL CONCLUSIONS

1 Polypoid decidual endometritis (with or without adherent placenta) is by far the commonest cause of serious puerperal sepsis.

Successful treatment consists in early removal of the diseased decidua, with a minimum of injury to the uterine tissue.

3 In skilled hands early removal of the diseased decidua is free from danger. In the presence of definite sepsis the possible risk of further infecting the uterus may fairly be taken.

4 With early removal of the diseased decidua the maternal mortality and morbidity are practically eliminated.

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THE USE OF BULLS SERUM IN THE TREATMENT OF WOUNDS INFLICTED WITH THE BACILLUS AEROGENES CAPSULATUS WELCHII

By ALFREDUS McCLANNIN M.D. F.A.C.S. B.A.T.M. C.

IN 1892 Welch and Nuttall described an anaerobic encapsulated bacillus isolated from a body which at postmortem examination showed the presence of emphysematous crackling in various situations. For several reasons it was argued that the emphysema was the result of an antemortem infection and not a cadaveric decomposition. Animal experiments with the organism proved this argument to be based on fact. The organism was named by its discoverer the bacillus aerogenes capsulatus. The name has since been shortened by popular usage to Welch bacillus.

Later studies were made by Welch and Flexner and the clinical application made by Bloodgood who pointed out the principle involved in the correct treatment. Several other clinical reports found their way into the literature but the subject did not attract great attention until the present war brought out an immense number of cases of infection with the organism, 70 per cent of wounds reported by Taylor and nearly 90 per cent by Fleming. From such frequent infection the number of cases of gas gangrene has been very large.

Considerable success may be obtained in preventing gangrene if the infected wound is seen and treated early. However the rapidity with which the infection and gangrene may develop is shown in Bowlby's report of a case in which the gas was present 5 hours after the wound was received, in gangrene and death following in 16 hours.

The organism grows on dead muscle and similarly damaged soft tissue and the infection spread along the sheath of the large vessels and nerves. The treatment of the infection therefore requires the removal of all such damaged tissue the opening up of the

course of the vessels and the use of suitable disinfectants. Of the antiseptics employed Dakin's solution is the most efficacious for reasons to be given later. The surgical removal of the damaged tissue will often require the nicest judgment in deciding between excision and amputation.

The infected muscle is easily recognized by its loss of contractility and its dirty brick red color as distinguished from the purple brown of the normal tissue. The usefulness of the limb after removal of all such tissue becomes an important factor in deciding for or against amputation.

The diagnosis of the infection is not difficult. The organism may be recognized in cover slip preparations and in 4 hour cultures. Routine examination of all suspicious wounds by these methods will permit a diagnosis in many cases before the development of gas and of gangrene.

Several theories have been advanced for the development of the gangrene and of the toxemia in this infection. The decomposition products of the infected tissue, endotoxin, absorption, acidemia and antitryptic action have each been advanced as the cause of the destructive action and fatal termination of the infection. Kenneth Taylor¹ advanced a theory that gangrene was produced by the pressure of the confined gas on the blood vessel causing necrosis; the necrotic tissue then being disorganized is the result of invasion by putrefactive organisms. He argued that the Welch bacillus acting as a saprophyte attacks the carbohydrate of the muscle producing the great quantity of gas required for the pressure. Taylor made a contrast between the action of the tetanus bacillus and that of the Welch bacillus in the body.

Carroll G. Bull and Ida Ritchett² of the Rockefeller Institute not only describe the true action of the Welch bacillus in producing

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gangrene and toxemia but also publish the production of an antitoxic serum.

This study proves that a highly potent soluble toxic agent is regularly produced by the bacilli on which their poisonous or lethal action depends. This toxic agent is an exotoxin and in this manner resembles the toxin of the bacillus of tetanus. The toxin produces two sets of effects according to the manner of injection into animals: (a) hemolysis following intravenous injection; (b) inflammation and necrosis of subcutaneous tissue and muscle following injection into these structures. In this action the toxin resembles the effects produced by the bacteria themselves. Suitable injection of a rabbit with the filtrate of a culture of the bacillus produced a blood serum capable of neutralizing the toxic substance causing the inflammation and necrosis and also neutralizing the specific hemolysis. It is interesting to note that *in vitro* five minutes contact with Dr. King's solution will destroy the toxin.

In an infection with the Welch bacillus it is shown experimentally that the injection of this antitoxic serum will prevent the development of the spores into the vegetative bacilli and also that the serum will deprive the vegetative bacilli of their toxic products which now appear to be their real offensive instrument.

The chief danger from infection with the Welch bacillus is centrally similar to that following tetanus infection. In both cases the toxic agent is an endotoxin yielded by the multiplying organisms at the focus of infection. There is however great difference in the local action of the two toxins. Tetanus toxin has little local effect while the Welch toxin produces marked inflammatory and necrotic change in the local tissue. The Welch bacilli therefore grow abundantly producing wide destruction of tissue in which process they are assisted by the ordinary pathogenic microorganisms.

We have therefore in the presence of a gangrene two processes to combat:

(1) The local growth of the bacteria which produces the toxin and in turn is aided by the action of the toxin on the tissue.

The systemic effect of absorption of the

toxin. The extent of this absorption is easily measured by the degree of hemolysis shown by the diminution in the number of the red blood cells. The temperature and pulse rate also indicate the extent of toxemia.

Injection of the antitoxic serum will neutralize both processes. The progress of detoxication may be followed by counting the increasing number of red corpuscles. When sufficient antitoxin has been administered the increase will be rapid and a difference of from one half to one million cells will be noted in two hours. With this increase there will be a fall in the temperature and pulse rate.

As soon as the condition of the patient warrants operation the gangrenous tissue must be removed by amputation or excision. This is important because re-intoxication has seemed to occur by absorption from the necrotic tissue. When amputation is done the operation must be a circular amputation without flaps, the guillotine method.

The dose of antitoxin used is from 5 to 15 thousand units, 7500 as an average given intravenously. At the same time about the same quantity is divided between 4 or more intramuscular injections given proximal to the area of infection. The intravenous injection should be repeated in two hours if no improvement is shown in the temperature, pulse rate and more especially by the increase of red blood cells. Anaphylaxis is not common when the successive injections are given at short intervals of time. The development of an anaphylactic shock under such circumstances in the presence of gas gangrene seems to indicate a fatal infection.

Through the kindness of Dr. Flexner and of Dr. Bull I have had the opportunity of treating 3 cases of gas gangrene with the serum. The cases are reported in abstract now.

CASE 1. Mercy Hospital, N. Y. (4). The patient, a white male, 46 years, was admitted to the hospital September 20, 1917, for laceration of the right iliotibial and thigh inflicted by a hot iron at home, ring 1 hour before admission. His temperature was 103, pulse 120, and expression anxious and general appearance that of a patient suffering from pyemic infection. The condition of the right leg and thigh at admission was small, tender, rounded by a thick layer of necrotic skin.

about 3x in hes l h at a crackled on p essure. The udate on the surf ce of the wound contained bubbles. Th re as brawny induration tend g back to the t berosity of the schium and down the th gh for a distance of 9 or 10 inches.

Imm diat ope ation was performed. An nc ion was made e tending abo e and below beyond th indurated area. The necrotic skin as e c ed. The felt d of the shell va moved and with it many small shot. The gangrenous t ssue was excised until the floor of the o nd showed only clean m cle and fascia. A numb r of blood vessels vere tied with ch om c catgut. C el tubes were introduced the wound d ssed and instillatio s of hloramine made ve v hours. The v ound was dressed daily and looked healthy. smears sho ing a fe bacilli for the f st few days. In spite of this condition of th wound th p t t remained toxic nd th refore on Sept mbe he va g n o cubic centimeters (oo un ts) of ntito n i to a v n of the arm. A imilar dos was given on th ne t day. The patient s cond t on continu d ne ntial unl the fo tteenth day wh n h dc elop d lo kja. F tl ousand un t of tetanus nt toxin er giv n i to his pin l canal aid the tptoms dis pp red vith n the ne t r ho s. On th ight c th day it s oted th t the fascia l t appeared n crot. Sme rs t ken from th ea hov d g s b lli. Anoth r dose f th antito n ag nst Wel h bacillus v s g en on tle t ty cond day d v s followed by an naphylactic r ct o. On the thurt eth day th ound v s p t ally clos d by suture and th pati t th n m de n uninterupt d r o ery.

C SE 2 Me v Ho pital No 44. Th pati nt s i t mai age 3 ho as adm t t d Novem b r o on acco nt of a compound ommunited f acture of the ght l g a d cl d f tu of the left leg cau d by a autom b l a dent. The v ound ere dis ncted th iode the fractur immobilized in padd d plants and th p ti nt s given prophyl ct c jction of tet nu nt to i. At 8 i m o No mb r 8 it s ted th the p t nt temperature l d dd ly to 10. The esd t surg on D k r ev to ce v m ned th wound f the ght leg nd noting emphy em nd i oloration m l o l p

prep rat n hich showed th Welch bacilli. Immediate amputation v s performed the patient being giv n 30 cub c centimeters of antitoxic serum ntra enou ly on the operat ng table. The limb was amput t d at the lower third of the thigh. The ound was dressed with dichloramine T in oil (65 per cent). The patient cont nued to ic with fe er of o. On November 11 he vas given another dose of 30 cubic centim ter of antito n intravenously and 60 cub c centimeters v e given into the muscles of the thigh abov the wound.

Aft r this injection the patient d v loped a severe anaphylactic reaction. His toxæmia b came d epe and although his ound clea ied up b cilli continued to be p esent in the smears. On Novem b r o the dichloramine T s replaced by in tilla tions of 2 p r cent chloram ne in water the pat ent ont nued to ic however and d d No ember 22. Postmortem examination vas not allowed. In this case the se ere anaphylactic shock p v nted our repeating the use f the ser i.

CASE 3 St Ag es Hosp t l No 0403. The pa tent a white boy age 11 years as admitted No vember 9 fi d ys aft l had r e d a comp d fra ture of both bones of the forearm near the wrist joint. On dmissi n it va noted that th pat nt was q t to t mp rat r i pulse 136. There was gangrene and crackl in the ound nd sme rs sho d the Welch bacillus. Th pat nt was anx thet ed th n trou o de nd th ound opened up. At the s i t me a dose of 3 cubic cent m trs of antitoxin vas given nto n n tl oth m E ploratio of th r gon of the fracture showed gangrene nvol ng the pronator qu dratus nd the tendo s of the d ep fl xo. Op ning up tl forearm near th elbow v l d g s d g n long the cour of the i tero scous v ss ls. The c s lso gang ene at the tt clment of the muscles to the nt rnal con dyl. Crc l r mp tation as thero do at th m d d l of the h m r s. The vessels w e ligated th ch m c catgut. C r l d k i d nct on as begun at onc. The p t nt impro d r p dly and on the t cnt cth day tle pr trid g bon as sa d off nd th tump lo d by utur. The wou d th n h l d r d the pat nt l f t l ho p t l ck ft tl clour.

DEPARTMENT OF TECHNIQUE

A UNIVERSAL FRACTURE FRAME COMBINING SUSPENSION WITH TRACTION OF THE LOWER OR UPPER EXTREMITY AND FLUOROSCOPIC CONTROL

ESPECIALLY USEFUL IN MILITARY SURGERY

BY CLYDE W. HAWLEY, M.D. BRIDGEPORT, CONNECTICUT

ONE of the great difficulties in the treatment of fractures of the major bones of the extremities is the fact that so many different apparatuses are needed to meet so many different conditions. This is still further complicated when fractures are associated with wounds of the soft parts as occur in such large numbers in modern warfare.

In order to simplify the problem I have designed a frame upon which the patient is placed and upon which he remains during all recumbent treatment and from which he does not have to be moved for any cause. He can be subjected to roentgen examination, transportation, wound treatment, application of plaster, and even operation without disturbing the limb in any way. Attachments are provided which furnish suspension or extension to either upper or lower extremity by the ordinary moleskin plaster straps by the Collin's ankle strap, the Steinmann nail, the Enochietto stirrup (Fig. 1) or the author's combination stirrup (Fig. 2).

Any one of three methods of suspension may be used all of which give complete exposure of limb for examination and wound treatment. The frame is so constructed that fluoroscopic examination can be had at any time without disturbing the limb or the traction. This permits of accurate and frequent roentgenologic control and is especially advantageous in military surgery for the location of foreign bodies as well as the approximation of the fracture.

When a case of fracture enters a civil hospital the immediate requirement is some sort of a temporary splint. Then the case must be submitted to roentgen examination. This requires transferring the patient from the bed to wheel stretcher, stretcher to roentgen table and then the process reversed. In case of a portable bed, used it is still necessary to transfer the patient from the bed to the table.

In any case it is generally necessary to remove the temporary splint and reapply it. All this entails unnecessary pain and traumatism which provides muscular spasm and opens the clots over the ends of the bones, increasing the hemorrhage and subsequent swelling.

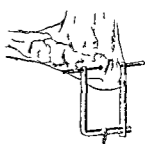
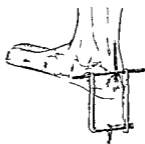
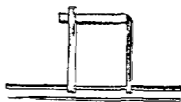
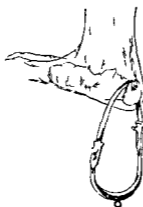
When continuous traction is used and Buck's Hodgen's or other forms of extension splints are applied, it is usually attached to the bed and the patient becomes as it were anchored to the bed. In the more elaborate apparatus for extension with suspension as used in the time of the Civil War with the modern modifications of the Blake and Brilkan splints, the patient is not only fastened to the bed but to an extensive arrangement of overhead framework. While these splints provide effective suspension which is so essential for wound treatment, there are so many parts, so many ropes and pulleys that it is always a difficult matter to keep the apparatus in working order and the traction in continuous operation.

With the patient in almost any kind of an extension apparatus it is almost impossible to obtain a roentgenologic examination without releasing the traction and removing the patient from the bed. Even when it is possible to move the patient and the bed, the overhead frame and guy ropes prevent a satisfactory examination and fluoroscopy is out of the question.

The apparatus herewith presented consists of an ordinary Bradford gas pipe frame (Fig. 3) over which canvas is stretched in a manner to make it taut and prevent sagging. In the center section are removable slabs so as to give greater stability at the point where the greatest weight is borne. Over the center of the frame is a gas pipe bridge which can be placed and locked at different points (Fig. 4). The uprights serve to support two vertical bars which act as perineal post and a point of fixation for counter traction. It also serves to support a ling



Fig. 5. Hip rest device. The device consists of a circular frame with a central support and a strap for securing the patient.



by which the patient's pelvis can be raised for the use of the bed pan (Fig. 9). The perineal post is lifted out when the bed pan is used. The posts also support a hip rest for the application of plaster (Fig. 5).

At the foot of the frame is an upright which supports two pulleys. The lower pulley is movable for adjustment of elevation. The rope passes under the lower pulley and up over the upper one. The object is to place the weight higher than is usually done and out of the way. An ordinary Hodgson hammock pulley is used to carry the leg (Fig. 4). To this pulley is attached a vertical sliding frame to secure control of the foot in the vent the tendency to outward rotation and to draw. The H. pulley is suspended either by a cord attached to the lower and center upright or by a bar resting on the center upright. Still another way of suspending the limb is by means of a ball and chain dropped down from the bar after the manner of the Balkan pulley (Fig. 7).

For treatment of the upper extremity an angular support is used which is attached to the side of the frame (Fig. 11). If pulleys are used the same as on the foot, traction is applied with the elbow flexed and the hand suspended to a short vertical bar. Either a sole skin strap or a padded linen tie at the end of the elbow or both may be used to secure traction.

When it is desired to apply plaster to the lower extremity after a period of extension after a wound has healed or after an operation it can be done by placing a platform under the shoulder and fastening a hip rest to the perineal post (Fig. 5). The traction on the way may be made secure by tying the pulley rope to the Bradford frame after removing the weight. The Hodges

split is then removed. Before the split is removed a Collin ankle trap is applied and attached directly to the pulley leaving the leg free and clear with extension still applied. If suspension of the leg at any point or flexion of the knee is desired it may be obtained by suspending from the horizontal bar (Fig. 8).

In the Carrel treatment of compound fractures the splint is suspended from the horizontal bar for allowing a direct flow and making a separate standard unnecessary.

The frame is a bed in itself and can be used in the traction by placing a support at each end (Fig. 1). It can be laid upon any bed having a platform. It is a simple matter to obtain elevation of either the foot or the head of the frame as desired.

The frame is also a stretcher or litter in itself and can be used in such patients can be transported with comparative ease and comfort as well as taken out for fresh air treatment.

The principal object of this apparatus was to secure fluoroscopic examination of fracture in traction. Believing with Robert Jones that extension when efficient is one of the best methods of treating fracture of the femur the problem was to devise some way by which the effect of traction could be observed from day to day without interrupting the continuous pull. The aim is to secure reduction by continuous traction. At the same time the effect of decreasing or di-

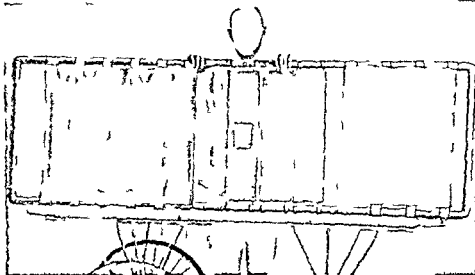


Fig. 3. Author's universal fracture frame, how the Bradford frame to which is attached devices for traction suspension etc. Canvas top support and lower sections and removable slat in center where there is a weight is borne. (Illustrations from photographic enlargements of motion picture by courtesy of the Clinical Film Company of New York.)

minishing the traction and the effect of manipulation are subject to accurate observation. When reduction has been obtained and held until the fragments are fairly secure (five to fifteen days) then the limb is encased in plaster and the patient is convalescent. The plaster is applied without moving the patient from the frame and without the risk of displacing the fracture ends (Fig. 10). If however satisfactory approx-

imation has not been obtained within a week or ten days, then open reduction may be considered but with an efficient traction apparatus which provides accurate roentgenologic control with a choice of several methods of applying traction with the use of sufficient weight applied early with the patient under ether upon a fluoroscopic table, the number of failures of reduction is small and the cases requiring operation are few.

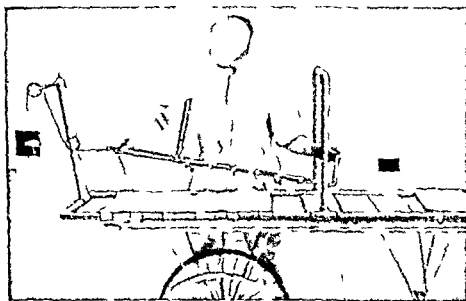
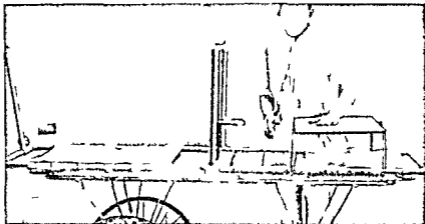


Fig. 4. Frame with central pulley and foot support shown. Head and plant attached to weight. Two or three feet are used. The lower pulley is adjustable so that the height may be regulated. The upper pulley keeps the weight in the line of the axis.

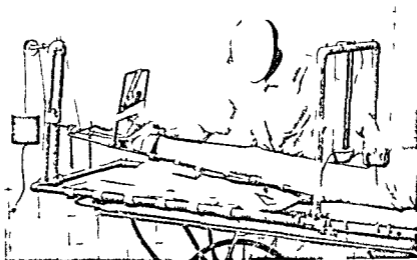


The traction apparatus for the treatment of fractures of the tibia and fibula.

In the treatment of fracture of the tibia either continuous or temporary traction may be used. In the former the direct pull of ten to fifteen pounds on the bone fracture itself is the most effective which is obtained by the Steinmann pin the Finchiert turrup (Fig. 1) or the author combination turrup (Fig. 2).

The amount of extension curdly a the live traps is entirely inadequate in fracture below the knee because the traction tray cannot be of sufficient length to support a weight which

will control the fragment. Traction by the Collin ankle trap is also impractical because the pad around the ankle is usually too near the site of fracture and the swelling involve the ankle as well as the leg. Effective temporary traction for immediate reduction of fractures below the knee is obtained by using the author traction turrup. It has always been difficult to apply traction at the ankle in order to effect reduction and immobilization of fracture of the tibia. By using this device which



The traction apparatus for the treatment of fractures of the tibia and fibula, showing the application of the device to the patient's leg.

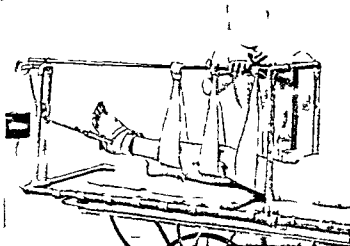


Fig. 7. Frame used to permit use of penile like the B. K. n. Useful in post-operative treatment.

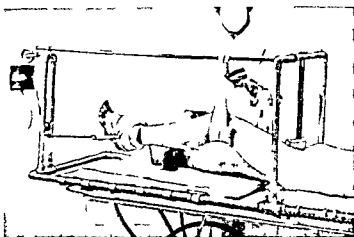


Fig. 8. Frame utilized to obtain traction with knee flexed similar to double inclined plane.

obtains traction by means of a bar resting on the upper surface of the sole cast. A satisfactory control is possible and after a cast is applied the pin can be withdrawn. This temporary traction is rendered accurate when performed on the fracture frame on the fluoroscopic table.

Simplicity is the secret of success with any mechanical device and for this reason all over head framework and the multiplication of ropes and pulleys has been avoided. At the same time a method of traction has been applied which is reliable and fool proof. Nothing can interfere with the traction after it has once been set up. One of the common defects of the usual method of employing extension is the fact that they permit of a certain amount of sliding motion which makes it necessary to keep the patient continually pulled toward the head of the bed so that the weight will operate but a Robert Jones has emphasized the mechanic of traction requires a fixed point from which the pulling force must be obtained. While a moving fixed point is logical a long traction force moves with it nothing is gained thereby except to add the fatal error of unreliability. Traction with the leg in abduction is obtained by using the arm attachment at the foot of the frame on either side. Abduction displacement except in fracture of the neck of the femur or through the trochanter is usually an indication that the traction is inefficient. Ordinarily the weight employed is not sufficient. At least 50 to 100 pounds should be used for surface traction and 10 to 15 pounds for direct pull on the bone structure (Steinmann pin etc). Pressure on the perineum is relieved by a thick felt pad and elevation of

the foot of the frame. The perineal posts may be raised and replaced as the occasion requires. Mattresses made in two sections are used and make the frame as comfortable as any fracture bed.

Fluoroscopic copy in one plane only is used because a view in an opposite direction is unnecessary. Occular observation in one plane gives more information than still pictures taken in two planes even stereoscopic impression because it is possible to use the effect of motion to watch the effect of manipulation and different degrees of traction. Roentgenograms furnish an approximate estimate of the relative position of broken fragments. The ability to observe the movements of the fragments by direct fluoroscopic copy supplies the same information. In addition it explains something which flat pictures can never do. It demonstrates the effect of

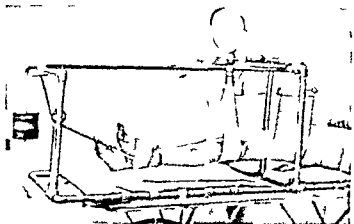


Fig. 9. Simplest case of patient held in position for operation. The first of the illustrations is a photograph.

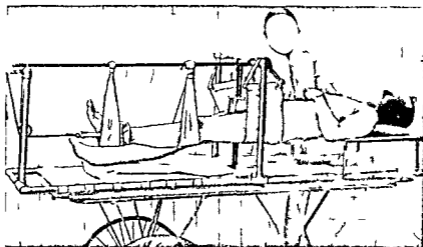


Fig. 1. The patient is lying on the table, which is tilted upwards. The table is adjustable and has a large wheel at the base. A person is standing at the head of the table, possibly a nurse or doctor, attending to the patient. The patient is lying on their back, and the table is tilted slightly upwards.

force applied from different directions on the fracture end and a bit in the intelligent effort to effect replacement.

Fluoroscopic not taking place of plate impression which are necessary for permanent record. Both should be utilized wherever the circumstance permit. Fluoroscopic examination should of course be made under proper

condition with the usual for this purpose in a lead lined box and with the goggles and curtain provided for this work. Fluorescent screen held by hand or supported by a ratchet handle with the tube box may be used. Each has its advantages. With the latter the surgeon is able to see his own hands for manipulation.

One of the large problems of modern warfare is the treatment of infected compound fracture. The fracture is unlike civil compound fracture because the wound are extensive and infected the bone fragmented and complicated by the presence of shell fragments and clothing. The surgical problem is threefold: the removal of foreign bodies, the treatment of an infected

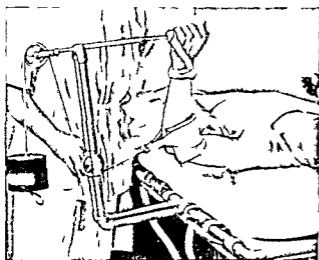


Fig. 1. The patient is lying on the table, which is tilted upwards. The table is adjustable and has a large wheel at the base. A person is standing at the head of the table, possibly a nurse or doctor, attending to the patient. The patient is lying on their back, and the table is tilted slightly upwards.

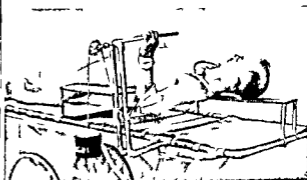


Fig. 1. The patient is lying on the table, which is tilted upwards. The table is adjustable and has a large wheel at the base. A person is standing at the head of the table, possibly a nurse or doctor, attending to the patient. The patient is lying on their back, and the table is tilted slightly upwards.

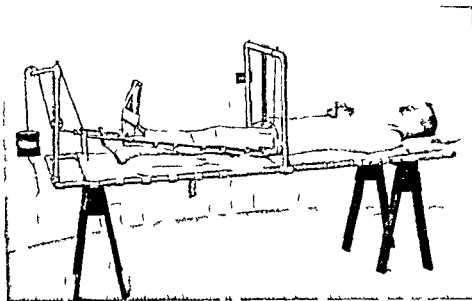


Fig. 13. Frame used as a bed or cot by resting it on supports.

wound and the treatment of a fracture. The localization and excision of substances carried into the tissues makes it necessary to explore and traumatize wound to a far greater degree than is done in civil surgery. At the same time more extensive wound treatment is required because of infection is the rule. This can only be effectively done by more or less complete exposure of the entire limb. Plaster of Paris has been used with extensive bridging or fenestration but its use has been almost completely abandoned because it is laborious when used in a few cases and out of the question when treating large number and the exposure is rarely sufficient.

Some comprehension of the size of this problem is obtained when it is appreciated that 25 per cent of the wounded returned to the battle hospital have wound associated with fracture.

Its importance is further emphasized by the fact that the reconstruction hospital of England and France are flooded with the effects of fracture deformity and competent observers agree that at least one half of these deformities could have been prevented. It is also pertinent that this field of military surgery has been more or less neglected.

Following a somewhat extensive experience with civil fracture, the writer had the opportunity of treating a large number of military frac-

tures in France and observing many hundreds in various other hospitals. It was apparent from a study of the cases that more efficient and extraordinary measures must be employed to control both the infection and the fracture. If the treatment of the infection is inadequate the result is chronic osteomyelitis and if the fracture is neglected deformity is almost inevitable.

In the apparatus herewith described the endeavor has been to overcome some of the difficulties usually encountered in the treatment of fractures by traction especially military fractures requiring wound treatment and at the same time provide effective fluoroscopic control because this form of roentgenological examination has become of fundamental importance in war surgery and offers a promising field for development in civil fractures. The usefulness of this frame has been confirmed by the tests to which it has been submitted in the treatment of industrial fractures and in some of the war hospital in France.

NOTE.—See these photographs illustrating a fragment has been made in the matter of construction. A single leg is used with upright support of the frame and permanent attachment to the limb is made by the use of a band not in use. The central bridge is made in three parts. The side bars being attached to the frame so as to enable the frame to be extended and retracted by a lever which also serves for the arm support. The end of the side bars.

CAST OF MINOR DISPLACEMNT OF THE LUMBAR VLRTBRÆ KIPPOSITION CURE

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process to the left of the middle line (Fig. 1). As the other vertebrae were in their normal position as regards one another the second lumbar vertebra was actually producing the obliquations of the line between it and the first and the other between it and the third lumbar vertebra.

As there is a lateral deviation of the body of the misplaced lumbar vertebra it can be assumed that the center of malstation is situated about the middle of it only. To estimate the amount of malrotation and to express this in degrees proceeded as follows: The deviation of the spinous process is approximately 2.5 millimeter and the distance from the tip of the process to the middle of the body is about 6 centimeter. Then the tangent of

$$\text{rotation} = \frac{2.5}{60}$$

Therefore the angle of rotation is .23. Of course this is only a rough estimate but it serves to show that an apparently slight displacement is really a large one. The maximum of rotation obtainable under normal conditions in the lumbar vertebrae average about 16 degrees each bone. Therefore the rotation therefore represents an amount of rotation greater than that obtainable in normal subjects.

The patellar reflex was more marked on the left than on the right side. An attempt to elicit ankle clonus

induced 1 or 2 jerks this was not the case on the right side.

Treatment. This was limited to passive adjustment for the lumbar vertebra and was applied on three occasions namely July 13, 15 and 16. The first time it was chiefly taken up by getting the lumbar muscles to relax during the second visit the second lumbar vertebra moved nearly into position. At the third visit it moved quite into position so that neither inpection nor palpation could detect any deviation from the middle line. The actual reposition was not only absolutely painless but almost free from any ordinary reaction.

The pain and stiffness were already better after the first visit and after the third they as well as the feeling of numbness had disappeared. The patient was able to walk without swinging her leg round in a semicircle. The patient declared herself to be cured. There was no change in the reflexes.

Following the patient again until March 6, 1915. There had been no return of any of the symptoms. She has no pain or stiffness and walks as well with the left leg as with the right. The reflexes are now the same in both legs and are normal.

A second roentgenogram was taken by Dr. Melville on that date his report is as follows: The malrotation of the lumbar vertebra appears to have been corrected. (Fig. 2)

A NEW METHOD OF TREATING FILIFORM STRICTURES OF THE URETHRA

BY HIO BUELLER, M.D., IACSS, NEW YORK

FROM the urological standpoint it is an interesting observation that the mechanical devices for attacking lesions demanding intravesical cystoscopic procedure have been more successfully developed and more easily applied than have those for the work in the anterior and posterior urethra regions seemingly more accessible. Thus it is strange but nevertheless true that the removal of a foreign body from the bladder is much more readily accomplished with our modern instruments (author's operating cystoscope and operating forceps) than if the same is lodged and impacted in the posterior urethra.

Filiform strictures of the urethra too belong in the category of the lesions that have hitherto been treated in an amateurish, haphazard and unskillful fashion. The old well tried venerable but often nerve wrecking frequently un successful procedure recommended by our great masters of urology consisted in the introduction of a number of filiform bougies with the hope that one of the might surmount the intricacies of the curved urethral passage and penetrate into the orifice of the coarctation. For further dilatation the method of Huguier and the use of Phillips

deserve commendation and support for by means of their bougies with the filiform once introduced the subsequent dilatation becomes a simple procedure. Perhaps the best of all the sounds for dilatation are the bougies or catheters of Phillips made of shellacked silk.

But even this ingenious idea of the ingenious use of multiple filiforms oftentimes fails either because of the eccentric position of the orifice of the stricture or the intricacies of the urethral channel or because of some other peculiar mechanical obstacle which nullifies our effort to reach the coarctated canal.

A better and more reliable procedure one that requires the exercise of more technical proficiency more deftness and experience is that which exposes the orifice of the stricture through an endoscopic tube and call for the insertion of the filiforms under the guidance of the eye. It has been my own routine for a number of years to proceed thus in the treatment of all strictures of the urethra that do not at once allow of the passage of a small silk bougie. It is an error of judgment that reaction the manipulation of numerous bougies of different style and magnitude through

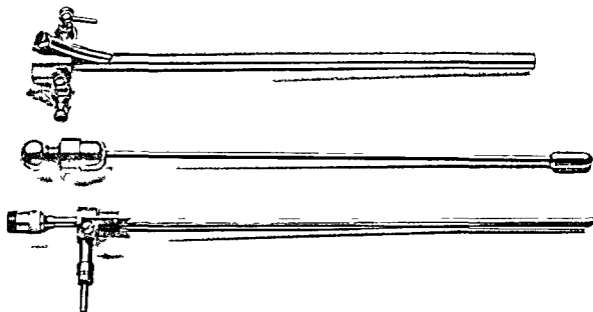


FIG. 3. A. B. C. D. E. F. G. H. I. J. K. L. M. N. O. P. Q. R. S. T. U. V. W. X. Y. Z. AA. AB. AC. AD. AE. AF. AG. AH. AI. AJ. AK. AL. AM. AN. AO. AP. AQ. AR. AS. AT. AU. AV. AW. AX. AY. AZ. BA. BB. BC. BD. BE. BF. BG. BH. BI. BJ. BK. BL. BM. BN. BO. BP. BQ. BR. BS. BT. BU. BV. BW. BX. BY. BZ. CA. CB. CC. CD. CE. CF. CG. CH. CI. CJ. CK. CL. CM. CN. CO. CP. CQ. CR. CS. CT. CU. CV. CW. CX. CY. CZ. DA. DB. DC. DD. DE. DF. DG. DH. DI. DJ. DK. DL. DM. DN. DO. DP. DQ. DR. DS. DT. DU. DV. DW. DX. DY. DZ. EA. EB. EC. ED. EE. EF. EG. EH. EI. EJ. EK. EL. EM. EN. EO. EP. EQ. ER. ES. ET. EU. EV. EW. EX. EY. EZ. FA. FB. FC. FD. FE. FF. FG. FH. FI. FJ. FK. FL. FM. FN. FO. FP. FQ. FR. FS. FT. FU. FV. FW. FX. FY. FZ. GA. GB. GC. GD. GE. GF. GG. GH. GI. GJ. GK. GL. GM. GN. GO. GP. GQ. GR. GS. GT. GU. GV. GW. GX. GY. GZ. HA. HB. HC. HD. HE. HF. HG. HH. HI. HJ. HK. HL. HM. HN. HO. HP. HQ. HR. HS. HT. HU. HV. HW. HX. HY. HZ. IA. IB. IC. ID. IE. IF. IG. IH. II. IJ. IK. IL. IM. IN. IO. IP. IQ. IR. IS. IT. IU. IV. IW. IX. IY. IZ. JA. JB. JC. JD. JE. JF. JG. JH. JI. JJ. JK. JL. JM. JN. JO. JP. JQ. JR. JS. JT. JU. JV. JW. JX. JY. JZ. KA. KB. KC. KD. KE. KF. KG. KH. KI. KJ. KK. KL. KM. KN. KO. KP. KQ. KR. KS. KT. KU. KV. KW. KX. KY. KZ. LA. LB. LC. LD. LE. LF. LG. LH. LI. LJ. LK. LL. LM. LN. LO. LP. LQ. LR. LS. LT. LU. LV. LW. LX. LY. LZ. MA. MB. MC. MD. ME. MF. MG. MH. MI. MJ. MK. ML. MN. MO. MP. MQ. MR. MS. MT. MU. MV. MW. MX. MY. MZ. NA. NB. NC. ND. NE. NF. NG. NH. NI. NJ. NK. NL. NM. NO. NP. NQ. NR. NS. NT. NU. NV. NW. NX. NY. NZ. OA. OB. OC. OD. OE. OF. OG. OH. OI. OJ. OK. OL. OM. ON. OO. OP. OQ. OR. OS. OT. OU. OV. OW. OX. OY. OZ. PA. PB. PC. PD. PE. PF. PG. PH. PI. PJ. PK. PL. PM. PN. PO. PP. PQ. PR. PS. PT. PU. PV. PW. PX. PY. PZ. QA. QB. QC. QD. QE. QF. QG. QH. QI. QJ. QK. QL. QM. QN. QO. QP. QQ. QR. QS. QT. QU. QV. QW. QX. QY. QZ. RA. RB. RC. RD. RE. RF. RG. RH. RI. RJ. RK. RL. RM. RN. RO. RP. RQ. RR. RS. RT. RU. RV. RW. RX. RY. RZ. SA. SB. SC. SD. SE. SF. SG. SH. SI. SJ. SK. SL. SM. SN. SO. SP. SQ. SR. SS. ST. SU. SV. SW. SX. SY. SZ. TA. TB. TC. TD. TE. TF. TG. TH. TI. TJ. TK. TL. TM. TN. TO. TP. TQ. TR. TS. TT. TU. TV. TW. TX. TY. TZ. UA. UB. UC. UD. UE. UF. UG. UH. UI. UJ. UK. UL. UM. UN. UO. UP. UQ. UR. US. UT. UY. UZ. VA. VB. VC. VD. VE. VF. VG. VH. VI. VJ. VK. VL. VM. VN. VO. VP. VQ. VR. VS. VT. VU. VV. VW. VX. VY. VZ. WA. WB. WC. WD. WE. WF. WG. WH. WI. WJ. WK. WL. WM. WN. WO. WP. WQ. WR. WS. WT. WU. WV. WW. WX. WY. WZ. XA. XB. XC. XD. XE. XF. XG. XH. XI. XJ. XK. XL. XM. XN. XO. XP. XQ. XR. XS. XT. XU. XV. XW. XX. XY. XZ. YA. YB. YC. YD. YE. YF. YG. YH. YI. YJ. YK. YL. YM. YN. YO. YP. YQ. YR. YS. YT. YU. YV. YW. YX. YY. YZ. ZA. ZB. ZC. ZD. ZE. ZF. ZG. ZH. ZI. ZJ. ZK. ZL. ZM. ZN. ZO. ZP. ZQ. ZR. ZS. ZT. ZU. ZV. ZW. ZX. ZY. ZZ.

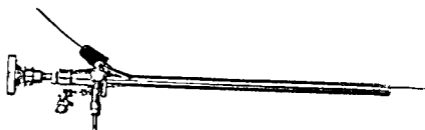


FIG. 4. A. B. C. D. E. F. G. H. I. J. K. L. M. N. O. P. Q. R. S. T. U. V. W. X. Y. Z. AA. AB. AC. AD. AE. AF. AG. AH. AI. AJ. AK. AL. AM. AN. AO. AP. AQ. AR. AS. AT. AU. AV. AW. AX. AY. AZ. BA. BB. BC. BD. BE. BF. BG. BH. BI. BJ. BK. BL. BM. BN. BO. BP. BQ. BR. BS. BT. BU. BV. BW. BX. BY. BZ. CA. CB. CC. CD. CE. CF. CG. CH. CI. CJ. CK. CL. CM. CN. CO. CP. CQ. CR. CS. CT. CU. CV. CW. CX. CY. CZ. DA. DB. DC. DD. DE. DF. DG. DH. DI. DJ. DK. DL. DM. DN. DO. DP. DQ. DR. DS. DT. DU. DV. DW. DX. DY. DZ. EA. EB. EC. ED. EE. EF. EG. EH. EI. EJ. EK. EL. EM. EN. EO. EP. EQ. ER. ES. ET. EU. EV. EW. EX. EY. EZ. FA. FB. FC. FD. FE. FF. FG. FH. FI. FJ. FK. FL. FM. FN. FO. FP. FQ. FR. FS. FT. FU. FV. FW. FX. FY. FZ. GA. GB. GC. GD. GE. GF. GG. GH. GI. GJ. GK. GL. GM. GN. GO. GP. GQ. GR. GS. GT. GU. GV. GW. GX. GY. GZ. HA. HB. HC. HD. HE. HF. HG. HH. HI. HJ. HK. HL. HM. HN. HO. HP. HQ. HR. HS. HT. HU. HV. HW. HX. HY. HZ. IA. IB. IC. ID. IE. IF. IG. IH. II. IJ. IK. IL. IM. IN. IO. IP. IQ. IR. IS. IT. IU. IV. IW. IX. IY. IZ. JA. JB. JC. JD. JE. JF. JG. JH. JI. JJ. JK. JL. JM. JN. JO. JP. JQ. JR. JS. JT. JU. JV. JW. JX. JY. JZ. KA. KB. KC. KD. KE. KF. KG. KH. KI. KJ. KK. KL. KM. KN. KO. KP. KQ. KR. KS. KT. KU. KV. KW. KX. KY. KZ. LA. LB. LC. LD. LE. LF. LG. LH. LI. LJ. LK. LL. LM. LN. LO. LP. LQ. LR. LS. LT. LU. LV. LW. LX. LY. LZ. MA. MB. MC. MD. ME. MF. MG. MH. MI. MJ. MK. ML. MN. MO. MP. MQ. MR. MS. MT. MU. MV. MW. MX. MY. MZ. NA. NB. NC. ND. NE. NF. NG. NH. NI. NJ. NK. NL. NM. NO. NP. NQ. NR. NS. NT. NU. NV. NW. NX. NY. NZ. OA. OB. OC. OD. OE. OF. OG. OH. OI. OJ. OK. OL. OM. ON. OO. OP. OQ. OR. OS. OT. OU. OV. OW. OX. OY. OZ. PA. PB. PC. PD. PE. PF. PG. PH. PI. PJ. PK. PL. PM. PN. PO. PP. PQ. PR. PS. PT. PU. PV. PW. PX. PY. PZ. QA. QB. QC. QD. QE. QF. QG. QH. QI. QJ. QK. QL. QM. QN. QO. QP. QQ. QR. QS. QT. QU. QV. QW. QX. QY. QZ. RA. RB. RC. RD. RE. RF. RG. RH. RI. RJ. RK. RL. RM. RN. RO. RP. RQ. RR. RS. RT. RU. RV. RW. RX. RY. RZ. SA. SB. SC. SD. SE. SF. SG. SH. SI. SJ. SK. SL. SM. SN. SO. SP. SQ. SR. SS. ST. SU. SV. SW. SX. SY. SZ. TA. TB. TC. TD. TE. TF. TG. TH. TI. TJ. TK. TL. TM. TN. TO. TP. TQ. TR. TS. TT. TU. TV. TW. TX. TY. TZ. UA. UB. UC. UD. UE. UF. UG. UH. UI. UJ. UK. UL. UM. UN. UO. UP. UQ. UR. US. UT. UY. UZ. VA. VB. VC. VD. VE. VF. VG. VH. VI. VJ. VK. VL. VM. VN. VO. VP. VQ. VR. VS. VT. VU. VV. VW. VX. VY. VZ. WA. WB. WC. WD. WE. WF. WG. WH. WI. WJ. WK. WL. WM. WN. WO. WP. WQ. WR. WS. WT. WU. WV. WW. WX. WY. WZ. XA. XB. XC. XD. XE. XF. XG. XH. XI. XJ. XK. XL. XM. XN. XO. XP. XQ. XR. XS. XT. XU. XV. XW. XX. XY. XZ. YA. YB. YC. YD. YE. YF. YG. YH. YI. YJ. YK. YL. YM. YN. YO. YP. YQ. YR. YS. YT. YU. YV. YW. YX. YY. YZ. ZA. ZB. ZC. ZD. ZE. ZF. ZG. ZH. ZI. ZJ. ZK. ZL. ZM. ZN. ZO. ZP. ZQ. ZR. ZS. ZT. ZU. ZV. ZW. ZX. ZY. ZZ.

the urethra in the hope that mere luck will lead one of these into the devious narrow passages. For in the clumsy, haphazard and inefficient use of a multitude of instruments the chance of success is minimized and often is completely nullified by the swelling, hemorrhage and pain that are occasioned. And when we consider that cases of filiform coarctation of the urethra are frequently overlooked and when retention of urine has taken place successfully of vital importance, the non-operative relief and often cure of failure means surgical intervention and its attendant evils in patients whose renal function is often considerably impaired.

Therefore I have completely abandoned the time honored introduction of multiple filiforms except in those cases where either because of the multiplicity or the deep situation of the stricture

the endoscopic method of approach is not applicable.

The finding of the crux of the stricture however is not always easy nor is success in the insertion of the filiform under the guidance of the eye given to any but those who experience in urological work has been adequate for the execution of the more delicate and intricate maneuvers. In the search for a simpler and more easily executed method, one that could be carried out even by the tyro in the cystoscopic and endoscopic work it occurred to me that the use of a specially constructed direct vision irrigation endoscope might solve the problem. And for this purpose as well as for other intra-urethral operative procedures I constructed an operating endoscope which incorporates many of the features of the Goldschmidt and Goring instruments. It

differs from the latter however in that it has a different optical system and different type of endoscopic tube and a different catheter outlet and because it permits of the introduction of operating devices of ample magnitude in fact all those suggested for my operating cysto-urethrocope.

Through this instrument it is feasible to pass filiforms of the Phillips type through the orifice of the stricture directly under the control of the eye and in my own experience it is not difficult to enter strictures that would otherwise be regarded as impassable.

*The operating urethroscope*¹ This consists of an ordinary straight endoscopic tube (Fig. 1) some what longer than that used for the anterior urethra and is furnished in sizes 4, 26 and 28 French or even larger if desired although the 4 is regarded as the normal size. Its ocular end carries the same cuff or reinforcement with irrigating faucets provided in the author's cystoscope and is luted out and jointed with water tight connections. Just beyond the cuff is a large catheter outlet of a pattern used in the author's operating cystoscope. This permits of the introduction of fairly large sized fulguration electrodes grasping forceps and of a No. 12 Phillips bougie for the dilatation of stricture. Two obturators are furnished one when the instrument is to be introduced into the bladder for incision and treatment of the neck of the bladder or posterior urethra the other when the anterior urethra alone is to be viewed or treated (Fig. 3).

The operating telescope (Fig. 3) consists of a very slender tube carrying a specially designed large angled lens system and a light carrier. When the telecope is fitted into the endoscopic tube ample room remains for the passage of operating device grasping and cutting forceps large fulguration electrode and filiform with crew end used for the dilatation of strictures and attachable to the Phillips type of bougie.

Although the urethroscopic picture obtained with this instrument are excellent it cannot be too strongly emphasized that this type of endoscope is not recommended for routine observation of the posterior urethra. The cysto-urethrocope described by the author and provided with the right angled lens system is far superior in every respect for the study and even for the treatment of the neck of the bladder and posterior urethra for it permits of repeated introductions and withdrawal without causing the slightest traumatic in-

jury. The straight tube type is bound to produce injury if an attempt be made to reintroduce it without the obturator.

Although this instrument has been found adequate in the treatment of filiform strictures of the urethra a more recent modification which shall be described in a future publication is deemed more generally useful in the diagnosis and treatment of lesions in the posterior and anterior urethra. This universal type of cysto-urethroscope built on the same lines as the one described except that the light carrier and telescope may be separately removed so that the conversion of the instrument from a water or irrigation urethroscope into an air and direct vision urethrocope can be more readily accomplished by the simple removal of the telescope.

The treatment of filiform strictures With the obturator designed for the anterior urethra in place and the patient in the usual cystoscopic position the sheath is introduced until it meets the resistance of the strictured area. The obturator is removed and the telescope with the filiform in place is inserted. While the assistant grasps the corpus cavernosum of the penis so as to prevent reflux of fluid the irrigating fluid is allowed to distend the urethra. The orifice of the stricture is now sought and can often be beautifully demonstrated as a sharply defined black hole centrally or eccentrically placed at times obscured by a shelf of scarred mucous membrane. By manipulating the filiform back and forth just as one would a ureteral catheter and by movement of rotation it can be readily made to enter the stricture and enter the bladder. The crew end of the filiform is now held or pushed inward and the telecope withdrawn. Now the sheath or endoscopic tube is removed care being taken not to dislodge the filiform. The further procedure of dilating the stricture is too well known to require further comment.

Because of the relative shortness of the Phillips filiform it might be hazardous to attempt to use the regular lengths for work through the urethroscope. Therefore specially long filiforms are recommended. If these are not available the following expedient will permit the operator to accomplish a safe introduction of the filiform provided that a No. 11 or No. 1 Phillips bougie or catheter is at hand. Introduce the filiform through the catheter outlet armed with a fitting rubber tip until it has passed the stricture and emerge by but a centimeter beyond the catheter outlet. Remove the rubber tip and attach either

¹ The patent for this instrument is held by the author. It is a modification of the instrument described in the author's "The treatment of the urethra" published by the author in 1911.

a No 11 or No 12 French Phillips bougie or catheter whose trumpet shaped end has been cut off With the tele cope removed carefully withdraw the endo copic tube pushing the bougie inward through the catheter outlet as the endoscope leaves the penis

Dilatation may then be continued with the Phillips catheter or bougie Or an Albarran or Maisonneuve urethrotome may be attached to the filiform already in the urethra and the stricture cut in the usual fashion

SUMMARY

In the hands of even those who have had but little experience in cystoscopic work this method of treating filiform strictures will be found to be so readily carried out that it will displace the two older inexact and unreliable procedures It should be instituted not as a method of last resort but at once before any other procedure has been tried and as soon as the diagnosis of filiform stricture has been established

HÆMOLYTIC SPLENO-MEGALY CURED BY SPLENECTOMY

B D L UPTIA SA S ASIAN SPIN

THE number of cases of hæmolytic jaundice which have been treated by splenectomy up to the present time is not more than 50 Therefore every new well studied observation should be recorded Another reason for reporting this case is that it is similar in all details to the case described by Banti under the name of hæmolytic splenomegaly of which there are but few cases published

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d t h t m t t h k 7 t u m t

Microscopically (Dr R. de Arcaute of Madrid) the chief histologic change was an intense congestion with perisplenitis and moderate hypertrophy of the trabecular reticulum and follicles.

This observation is embodied fully in the hepato splenomegalic variety of acholuric jaundice of Gilbert. This case was one of polycholic dissociated (purely pigmentary) and acholuric icterus that is to say the old form of hæmatogenous jaundice synonymous at the present time with jaundice through hyperhæmolytic.

We could also present it as a case of acquired chronic hæmolytic jaundice (Hayem Widal) but we consider it better to call it hæmolytic splenomegaly as it comprises all the attributes assigned by the celebrated pathologist of Florence to the morbid entity described by him in 1911 and 1913 in *La Semaine médicale*.

For Banti with whose opinion we entirely agree the name of hæmolytic jaundice is undoubtedly a collective name comprising a number of undefined and unsatisfied clinical entities differing in their etiology and pathology. In this provisional group he believes to have clasped a morbid type the pathogenic factor of which are the following:

1. A hæmolytic agent whose nature and origin in the organism are unknown is capable of exciting hæmolytic activity in the spleen.

2. A hæmolytic hyperactivity of the spleen due to the cytohemolins. This reveals itself morphologically by the increased volume of the organ.

3. Anæmia a direct consequence of the hyperhæmolytic.

4. Icterus also a consequence of the same.

Of the four pathogenic factors the first three are constant and indispensable but the fourth is not constant and may possibly be absent. Therefore the name of hæmolytic jaundice is not adequate in this instance because jaundice is not a constant symptom. Therefore it is prefer-

able to call it hæmolytic splenomegaly or hæmolytic splenomegalic anæmia.

The morbid conditions based on this pathogeny are not only represented by hæmolytic splenomegaly but form a mixed group of cases called splenohæmolytic comprising in part at least the acquired hæmolytic jaundice of Hayem Widal and in part also the congenital hæmolytic jaundice of Minkowski Chauffard as proved by the results obtained by splenectomy in the case of Roth and that of Zeri and Rubino.

There is a tendency at present among surgeons to consider splenectomy as the treatment par excellence of all cases of hæmolytic jaundice which is a exaggerated as the conservative opinion of Chauffard who considered them not surgical cases.

We are still wanting in certain details to affirm that all cases of chronic hæmolytic jaundice have as a basis this pathogenic process in which removal of the spleen will assure a cure. For this reason it is useful to distinguish with a particular name the cases in which this pathogenic process is indisputable.

Besides Banti's two cases there are three other cases in the literature of hæmolytic splenomegaly cured by splenectomy: these are those of Michel Antonelli and Fiori.

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ETHYL CHLORIDE AS A GENERAL ANÆSTHETIC OF CHOICE IN OPERATIONS OF SHORT DURATION WITH SPECIAL REFERENCE TO ITS VALUE IN WAR SURGERY

B. FREDERIC HACLER, M.D., St. Louis

ROBERT L. BOWEN, M.D., Chicago

Anterim chain of circumstance leads the contributor to offer the following observation.

When our American Unit, United States Army, in July 1916 we found that ethyl chloride had been employed frequently though not extensively for inducing general anesthesia. The practice was immediately ordered to be discontinued upon ground of its extreme danger. The kindly yet repeated assurance of the surgeon and the relative safety of the method as well as the very evident reluctance with which it was given up prompted us to search in the literature of the subject for convincing proof of the grave danger involved. To our profound astonishment we discovered in the reference to the proportionate incidence that our initial impression was founded upon the contrary, the majority of qualified authorities recommended ethyl chloride as safe and efficient when administered for transient anesthesia. Upon reflection we were reminded that our impression concerning its danger was based neither upon personal experience (which was nil) nor upon definite information. Our inferences had been drawn rather from the complete omission of the subject by our medical instructor or its perfunctory mention with the admonition *dangerous*. We accordingly reported to our superior that the practice might be resumed in suitable instances. Our hospital with a capacity of 450 beds occupied partially by wounded from the front and partially by acute surgical cases from adjacent training camps and prior to our coming furnished abundant opportunity for its employment and the result in a few hundred cases were ratifying in the extreme. This experience proved so instructive that we felt we a detailed account of our observations may be of service to many surgeons who possess a little knowledge of the usefulness of ethyl chloride as we did at that time.

In establishing indications for the employment of ethyl chloride as a general anæsthetic agent we desire to emphasize its suitability only in case requiring an anesthesia of short duration. It is not adapted for one reason or another is unsuitable. Every surgeon encounters numerous

instances in which he hesitates to employ local anesthesia on account of the time and trouble involved in the preparation of appropriate apparatus and anæsthetic agents. These instances are multiplied in the experience of the military surgeon on active duty. Furthermore infiltration frequently cannot be easily done on account of inflammatory processes, infection or inaccessibility of the field. Chloroform and ether possess so many obvious disadvantages as to lead very often to the decision to dispense with anesthesia altogether, a compromise both unsatisfactory to the surgeon and painful to the patient.

In precisely such instances ethyl chloride indicated. Reference to our note shows the following variety of cases in which it was employed: incision and drainage of abscess (including solar and peritonillar abscess), incision of turuncle, incision and excision of carbuncle, curetting of wound and ulcer, cautery of wound and ulcer, enlargement of wound for drainage in retention of drain, removal of drains and pack, removal of dressings, local suturing, skin wound operation for removal of nail, toenail, removal of nail, removal of foreign body, incision of tympanic membrane, excision of tissue for examination as preliminary to ether in certain leg and foot amputations.

Coming next to the frequency with which these conditions are observed both civil and military surgeons are directly necessary. We were much impressed however by the prevalence of abscess, furuncle, carbuncle, paronychia, infected ingrowing nails, suppurative adenitis, et al., among soldiers and particularly in recruits during their initial period of training. In all these inflammatory conditions local anesthesia is desirable because the hyperensitive inflamed tissue cannot be painlessly infiltrated. There is further objection that infiltration may actually precipitate the needle or the infiltrating solution. Curetting and excision of wound to remove neglected exuberant granulations often necessary. Granulations themselves are not sensitive but the margin and base of the wound or ulcer are frequently highly sensitive.

as well as too extensive for infiltration. The necessity for enlarging infected wounds and inserting drains are much less seldom in civil than in war surgery. The same holds true for the removal of heavy packs and large tampons inserted primarily to control hæmorrhage. In war hospital the same must often be removed with great discomfort to the patient unless he be anesthetized or morphinized while limited time and exigencies of service often prohibit the latter. Many large lacerated wounds open stump etc. are received from the front with dressing dry crusted and firmly adherent. Removal of the dressings in ethyl chloride general anesthesia is much more humane under these circumstances than rudely tearing them away, and vastly more agreeable to both surgeon and patient than spending valuable time in loosening them by picking. Doubtless a wider experience will increase the range of applicability but these examples suffice to define our conception of the indications for its administration.

TECHNIQUE OF ADMINISTRATION

Preliminary preparation or medication is unnecessary. On general principles it is preferable that the stomach be empty but by no means do we regularly observe this precaution. Needless to say all loose objects should be removed from the mouth and the respiratory passages should be clear. We insisted that mouth gag tongue forceps etc. be always at hand although no occasion for using them ever arose. The patient should lie with the head low and the clothing loosened at the neck. Removal of at least the outer clothing is advisable. Restraint is not necessary. However the patient should be well watched on account of an occasional momentary lapse of excitement during the recovery. The eyes are covered and a quart of gauze placed over the nose and mouth. The pad should consist of about ten layers of gauze with medium mesh. The patient is instructed to count slowly and ethyl chloride is then sprayed or better rapidly dropped upon the gauze. Within one half minute to two minutes anesthesia is complete as evidenced by the patient ceasing to count and by the deep, effortless respiration. The ethyl chloride may be cautiously continued for two or three minutes before being discontinued. The gauze may remain in place because this lengthens the period of narcosis and having been once withdrawn we never permit immediate readministration of the anesthetic. A complete anesthesia persists for two or three minutes from the discontinuance of the ethyl chloride

after which consciousness returns rapidly often instantly. An analgesic stage not infrequently precedes and follows the period of profound anesthesia. There may be a brief stage of excitement just at the waking moment. Perspiration is sometimes profuse but aside from this there are no unpleasant after effects. Headache, nausea and vomiting practically never occurred in our experience and ambulatory patients were permitted to depart unattended within a few minutes after recovery.

When the stage of complete anesthesia has been reached it may be easily continued with ether by simply substituting the gauze pad with a mask saturated with ether and from this point employing the usual drop method. This manner of shortening the period of induction of narcosis is often of great value especially in military hospitals and dressing stations near the front.

The following averages are furnished from records kept by Miss Emma Gruel the anesthetist of our Unit.

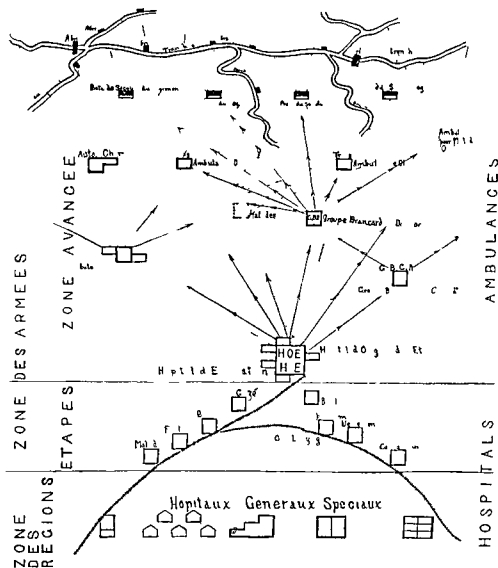
The pulse rate immediately prior to the administration of the anesthesia was 90 immediately after recovery of consciousness 92. The stage of complete narcosis was reached in 1 minute more than one minute after beginning the administration and continued for two minutes after discontinuance. The entire period of complete anesthesia was slightly less than four minutes. Recovery of consciousness was prompt and no complications during or following the anesthesia were noted.

It should be observed that no prolonged anesthesia was attempted. Although anesthesia was profound there was seldom complete muscular relaxation and on this account the anesthetic was not satisfactory in the reduction of dislocations and fractures.

SUMMARY

In summarizing our observations we may again state that when clearly indicated and when administered according to the described technique ethyl chloride is preferable to local anesthesia because the patient is spared all pain and because there is great conservation of time and energy. In the stress of active military service simple and time saving procedure are welcome and compared with ether and chloroform ethyl chloride has the advantage of being more rapidly effective of producing a transient anesthesia from which recovery is immediate and of freedom from disagreeable after effect. It is also simple of administration and in an emergency may be given by persons altogether unskilled in the technique of anesthesia.

We offer the following conclusions:



Esq. F. SWYLLY

1 to 11 are often finely equipped both as to personnel and material and are expected to handle *blessés* *graves* (seriously wounded)

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e Division head quarters for b and dic of whom there
m y be too or 50 It is not a hospital It is in charge of
a doctor who may be a captain a lieutenant or a sous
lieutenant Also there is an avul ary off cer (not a doctor)
a denti t 4 chemists (pharmacists) The G B D fu nishes
b c d e s to regiments as needed Usually a part of its
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p ng or bu ying them ma k ng th gra es and keep ng
areful eco ds of the vork Nobody brought in is buried
untl the cross and the data for marking the gra c e
p p d for unmd dead placing up n the spot There is
a l a c r ymna t e ry G B D l l en somet mes cooking
is done at G B D for P stes d S cor s although it is usually
n o ided for at the latt

imbalance of the population. There is an acute and important urgent hospital here often much operative work is done still patients are not retained here longer than necessary to make them transportable.

H O E or *HOE* (Ash ol ay) is a Hospital which is located at the line di- *de* the *Zone des Flapes* (or stages of a march) and the *Z nedel tra it* (before advanced) and therefore named *Hop i ld O ginc des Elapes*. During the war it has often been called *It pitad d Exac at on*. It is usually at a railroad and though it may be installed in barracks or even in tents it is more or less permanent for war times. It is really a group of ambulances (hospitals) under one management. It is likely to be in charge of a colonel a commandant (next grade above captain) or at least a captain and has a staff of administrative officers. It has not only a *t sage* and general surgical but often many special departments such as for treatments for general disease for ophthalmic otolaryngologic for gas poisoning for burns dental and prosthetic cases and for ordinary illnesses. It has a quite complete radiograph and bacteriologic departments in connection with specialists in charge. Still it is not intended to be kept filled with patients but always to have plenty of room for an influx. Consequently wounded or sick who need a longer stay in the hospital are evacuated still further to the rear as soon as they are transportable. Patients who are

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Elasticity of the service. It is of course understood that any station may be augmented or diminished in personnel and material from its usual strength according to exigencies and that any of the stations may be situated with anther or several others for example the *Poste de Service Régimentaire* may be omitted altogether so that farther back and used for *trage* or *G B D* may be located with *trage* or there may be one or three instead of two *trages* which is something analogous to our dressing stations. There may be *Postes de Service du Bataillon* instead of those of the *g n t c*

Also of course distances behind the lines and between stations are subject to the wide variation according to the terrain and the nature of the military activities.

The high administrative offices. The entire *Service de Santé* of the French military establishment is under the authority of the *Ministre de la Guerre* who appoints a *sous Secrétaire du Service de Santé* and next in authority and located at GQG (*Grand Quartier Général*) is the *Médecin Inspecteur Général Chef Service de Santé des Armées d'Opérations*. Under him are the *Médecins Inspecteurs Directeurs du Service de Santé de l'Armée* one for each of France's ten armies. Next in order are the *Médecins Inspecteurs et Médecins Principaux Directeurs du Service de Santé de Corps d'Armée*. The rank above the *Médecins Divisionnaires* one for each division.

Ambulan de All l
 S m l W F l l M D F A C S

TRANSACTIONS OF SOCIETIES

CHICAGO GYNECOLOGICAL SOCIETY

REGULAR MEETING HELD APRIL 20 1917 WITH THE PRESIDENT DR CHANNING W BARRETT
IN THE CHAIR

CÆSAREAN SECTION IN HEART LESIONS

DR CHARLES E PADDOCK A pregnant colored woman 32 years of age was admitted at term in her first pregnancy to the hospital suffering with much dyspnoea œdema of the lower extremities and pulmonary œdema The heart murmurs could not be differentiated and there was evidence of a dilated right heart with mitral insufficiency and myocarditis The face was very much congested and swollen eyes glassy and bulging The feet and hands and legs were œdematous The urine showed granular casts and 1 per cent albumin The cervix was long and undilated The patient was in a desperate condition Under gas anesthesia the classical cæsarean section was performed A living child weighing 8 1/2 pounds was delivered

The general œdema gradually disappeared but breathing was very difficult for 10 days The heart symptoms improved The prognosis in this case was good

Two per cent of pregnancies are complicated by heart lesions and such cases are always serious the seriousness depending upon the degree of compensation In many cases the cæsarean operation offers the only hope for the patient

This second case a young colored woman had the pelvic measurements of Baudelocque 16 5 cubic centimeters crests 25 cubic centimeters and anterior spines 22 5 cubic centimeters No date was given as to the last menstruation The fundus was well up under the ensiform and the head was overriding the symphysis The head was small occiput to left and the sutures well open

The size of head condition of sutures and race are important factors in determining the mode of delivery in such cases A colored woman will usually give birth to a child at term in a contracted pelvis when a white woman would not This case will be given a test of labor and operation will be undertaken only when such test proves the advisability of doing so

DISCUSSION

DR N SPROAT HEANEY What does Dr Pad-

dock mean when he speaks of the test of labor?
DR PADDOCK The woman should be allowed to enter labor the cervix should be allowed to dilate and it should be observed whether the head molds The membranes should remain unpunctured

DR HEANEY I have been in doubt whether cæsarean section is ever a procedure of choice in a patient with incompetent heart One particular thing in the treatment of a patient with an incompetent heart is rest and quiet After cæsarean section there is considerable pain from the incision and from gas pains the patient's sleep is disturbed and the advantage of the rapid delivery is offset by the stormy convalescence and by the operative shock I have never performed a cæsarean section on a patient with incompetent heart I prefer to allow the woman to go into labor naturally preventing her from bearing down as long as possible giving her morphine to relieve the pains as much as possible and as soon as the expulsive stage is reached advise delivery with forceps under deep anesthesia

DR GEORGE W LEE Some of our cases in the County Hospital have shown great recuperative power under stimulation after rupture of the membranes Usually the first stage of labor is markedly shortened and there is much less work to be done during dilatation I believe we should watch these cases closely during dilatation and upon the observance of any serious indication deliver through the vagina with complete dilatation if necessary

DR C S BACON I agree with Dr Heaney's view Unless there is a contracted pelvis or some reason for anticipating a long and hard labor the first stage of labor might be easy and relief from possible heart weakness later could be obtained through the use of the forceps

A conjugata vera of 7 1/2 centimeters means a very small pelvis and the probability of spontaneous delivery is not very great according to the symposium at the International Congress at Rome but the general consensus of opinion was that spontaneous labor is usually better than operative delivery If there were some 33 to 40 per cent of chance of delivery it would be better to try it I do not think a four to six hour trial in contracted pelvis is sufficient I think a forty or fifty hour trial is better The head often does not mold early

I always try to get the dimensions of the head during the last week by the Mueller impression so that we can get an idea of what the head will do

DR GEORGE W LEE Race should be considered a factor in these cases

DR PADDOCK (closing) There was no gastric disturbance in this case. Catheterization was however necessary. This is only my fourth heart case where caesarean section was performed and in each case there was a great loss of compensation and the patient was in a very grave condition. Complete recovery has occurred in each.

MIXED TUMOR OF THE OVARY

DR GEORGE F. DICK The patient had been sick three weeks. The onset as sudden with pain in the back. There was no chill, fever or vomiting. The pain extended bilaterally down the back and into the hips. It was dull at first but grew gradually worse.

The heart was slightly enlarged but there were no diagnostic symptoms. The roentgenogram for kidney stones was negative. The patient was in the hospital about three months then died. About three weeks before death a number of tumors appeared, one in the shoulder and two on the side of the chest. A pelvic tumor was found. On post-mortem examination the right ovary was found to be not affected, the left ovary was replaced with tumor tissue but was not enlarged. The uterus was filled with tumor masses varying in size from that of a pinhead to a chickory nut. The tumor had spread by way of the lymphatics involving the glands along the iliac vessels and the aorta so that the tissues around the aorta and the adrenals were embedded in tumor tissue. The posterior and anterior mediastinum were filled with tumor tissue. The pericardial cavity had been invaded and was filled with bloody fluid. The tumor extended into the cavity of the heart. After it reached the heart metastasis took place by way of the blood stream and bony tumors were found. Tumors were found beneath the impacted mucosa of the stomach. The histology of the tumor was that of typical sarcoma and carcinoma.

ABDOMINAL TUMOR WITH METASTASES

DR W. J. SCHAEFFER The patient was a negro man 53 years of age who entered the hospital suffering with weakness, loss of weight, vomiting, hoarseness and shortness of breath with considerable swelling of the feet and ankles. The trouble was first noticed last January. It began with pain in the right iliac region and went to the groin. Also the upper part of the chest was painful and the pain was aggravated by breathing but was not associated with cough. It lasted weeks and was followed by vomiting. The vomiting was better but contained no blood. The patient became progressively weaker.

On examination she was found to be slightly emaciated with slight jaundice of the sclera and skin. The right ventricle as thought to be dilated. The abdomen was distended, the contents were fluid. The liver was enlarged. There was pain on the costal margin. Some leucocytosis was

present. A diagnosis of carcinoma of the liver with ascites and dilated right heart was made.

The patient lived about 48 hours after admission.

On autopsy the thoracic cavity and lungs were found to be very small but no nodules were present. The heart was fatty and the right ventricle was dilated. The heart was not large. The myocardium was soft and flabby. Two and a half liters of clear fluid exuded from the abdomen. The liver was markedly enlarged to the left and was fatty, weighing over 9 pounds and a half. Just under the capsule were multiple small white patches not elevated; there was no puckering and the centers were not depressed. The gall bladder was not visible. One third of the total area of the liver was inolved with nodules of varying size up to three centimeters in diameter. The gall bladder bile as almost white.

In the right kidney a nodule could be palpated. This proved to be a hypernephroma surrounded by pearly white tissue. No right adrenals could be found; it was probably incorporated in the tissues surrounding the hypernephroma. There were a few benign myomata. There were no gross tumors in the ovaries or tubes. The autopsy findings indicated this to be a case of primary carcinoma of the kidney with metastases into the liver and into the adrenal glands and into the aorta and lymphatic glands.

OVARIAN ABSCESS

DR LESTER E. FRANKENTHAL An attempt was made by the patient to terminate the pregnancy. She said something passed. We found a centrally located tumor reaching from the pubes to within three fingers breadth of the umbilicus, freely movable, pear-shaped in position, shape, movability resembling a pregnant uterus. She had no elevation in temperature and also an increased leucocytosis. On bimanual examination we felt certain that this central mass was not the pregnant uterus but an inflammatory mass and that the uterus was placed behind and to the right of the aforesaid mass. Abdominal section as done yesterday morning. We found an ovarian abscess such as adherent to the bowel, abdominal parietes and bladder. At first we attempted to enucleate the abscessed ovary but since we found in many places the adhesions between the bowel and the tumor, it to intimate we decided closed off the peritoneal cavity from above and around the tumor by securing the peritoneum to the walls of the mass.

The incision was tunneled all around and sewed on to the fascia. The abscess as then incised to the extent of 2 to 3 cubic centimeters, a perforated drainage tube inserted surrounded by gauze. Gauze pack will be modified tomorrow and a shorter drainage tube left in situ.

As you all see it is no nearly 34 hours since the operation and the patient is in excellent condition. We are showing this case first in account

of the difficulty of making a diagnosis and of eliminating pregnancy and then on account of the way we treated the abdominal incision before opening the abscess (The speaker referred to another case one of uterine pregnancy with distinct Hegar's phenomenon The cervix and the body of the uterus seemed to be entirely separated one from the other) The size of the pregnant uterus its position its shape and its movability in this case are identical with the previous case

DISCUSSION

QUESTION Is it your opinion that this abscess of the ovary was the result of infection?

DR FRANKENTHAL Yes The infection in pregnancy is more likely to pass up along the ovarian ligament from the uterine cavity than to the tubes Ovarian abscesses can usually be traced to an infection in a previous pregnancy which is not the case with tubal abscesses They usually are caused by gonorrhœal infection

Since the surgical treatment carries with it a mortality of only 0.5 per cent in well prepared cases I am bitterly opposed to the X ray treatment in fibroid tumors of the uterus for the operation removes the fibroid tumor and through the removal of the fibroid tumor does away with all chances of malignancy in that uterus and through the removal of the fibroid tumor the brown atrophy of the heart muscles soon disappears Moreover it is frequently impossible to make an absolutely correct diagnosis of the adnexa complications of a fibroid tumor such as cystic ovaries tubal tumors either of an inflammatory nature or of extra uterine origin Ovarian cysts have frequently been mistaken for fibroid tumors and vice versa

To my mind the X ray treatment is only indicated in cases of uncompensated heart disease or kidney disease or in very old women or in those who are terrified at the prospect of an operation

We recently operated upon a patient who had received 18 treatments with X rays for a supposed fibroid tumor of the uterus The tumor turned out to be an ovarian cyst freshly adhering to every thing an abdominal tumor might become attached to The adhesions however were recent and were easily separated making the removal of the tumor *in toto* quite possible The uterus was enlarged passively congested with the tumor mass on top of it This accounted for the hemorrhages from the uterus which misled the diagnostician

I will not say how often malignancy occurs in a certain number of cases because personally I have not had the opportunity of examining each fibroid in every uterus removed for fibroid tumors of the uterus sufficiently carefully to make a percentage statement of any value but in my experience as well as the experience of every gynecologist malignancy occurs sufficiently often in our fibroid work every year to make us hesitate to suggest X ray treatment on that account alone Besides the X ray treatment is frequently followed by various

complications as was evidenced in one case in which there was great induration swelling and itching of the skin over the lower abdominal wall which condition resembled an elephantiasis

The literature teaches us that fatal hemorrhages have occurred after X ray exposure The glands of Lieberkuhn can be destroyed in three days in a dog exposed to X ray and thus a fatal diarrhœa may be produced The birth of a malformed litter is said to have resulted from X ray exposure

The medicolegal aspect of the question is important since if you recommend X ray treatment for a uterine fibroid where a malignant tumor may co exist you might make yourself criminally liable

DISCUSSION

DR HEANEY Do you close the wound ordinarily?

DR FRANKENTHAL The wound was kept open and the skin was turned in

DR HEANEY It was brought down to the fascia and covered over the fat after?

DR FRANKENTHAL Yes so as to avoid as much infection of the abdominal wall as possible The edge of the muscle was not covered because this would render the opening too small

DR CURTIS Would you put radium in the same category with the X ray so far as its effect on the ovary is concerned?

DR FRANKENTHAL No I would not because radium does not produce an artificial menopause

Answering your question more fully Dr Curtis I would say however that I must include radium with the X rays in the treatment of fibroid tumors in view of the many complications spoken of before such as malignancy abscess formation necrosis as well as wrong diagnosis when fibroids may be complicated by extra uterine pregnancy adnexa diseases and other complications

I am reminded of a case that I was asked to see just before she was placed on the operating table to be operated on by another surgeon for a carcinoma of the rectum I made a diagnosis of a fibroid tumor adhering to the rectum with no rectal disease The abdomen was opened and my diagnosis was substantiated by the local findings but since the surgeon had made an X ray and clinical diagnosis of carcinoma he hunted for any disturbance higher up in the bowel and found high up in the abdomen a stricture of the bowel which would never have been discovered had it not been for the abdominal section and therefore the patient was relieved of her symptoms which would not have been accomplished had she been treated by X rays for the fibroid tumor

In conclusion I would like to state that several patients have confided in me that they felt quite aged after X ray treatment

DR JOSEPH L BAER In this connection I would mention a case of polyp at the internal os with the presence of multiple fibroids in which laparotomy disclosed a right extra uterine preg-

nancy. This is an illustration of what has been pointed out i.e. the folly of employing the X ray.

Dr A. H. CURTIS. We have discontinued the use of the X ray for these purposes and are employing radium.

Dr N. SPROAT HEANEY. A surgical procedure I consider the first choice in the treatment of fibroids of the uterus. I do not think that every fibroid of the uterus needs treatment and believe that only those producing symptoms should be treated. In the event that an operation is contra-indicated I favor the application of radium since it can be placed at the seat of the difficulty without the danger accompanying the X ray. The contra-indications for operative treatment however occur so seldom that necessity for another treatment rarely arises. I am however opposed to routine treatment of fibroids by any other method than by the operative procedure.

Dr CHANNING W. BARRETT. Surgery had solved the fibroid question before radiotherapy came into

use. Once many things were employed to keep the fibroids from growing, waiting for the menopause or producing an artificial menopause by the removal of healthy ovaries so that the diseased structure might remain and cause trouble. When hysterectomy came into vogue the diseased structure was removed and the healthy structures such as the uterus and ovaries were left. After all this problem has been settled some one now proposes again to deal with the diseased fibroid by beginning about the menopause. We do not think that it is rational to deal with a fibroid uterus by destroying the function of the ovaries. The usefulness of the ovaries should be preserved. The use of the X ray should be limited to stopping hemorrhage from fibroids in a patient who is not in a condition for operation. Even in such cases the rays should be cautiously employed because their use obliterates lines of demarcation and renders the subsequent removal more difficult. The X ray has very little use in a uterine fibroid condition.

CHICAGO SURGICAL SOCIETY

REGULAR MEETING HELD FEBRUARY 2 1917 WITH DR WILLIAM FULLER IN THE CHAIR

COLLOID GOITER

Dr PAUL F. MORF. I have a specimen of goiter I wish to show which I moved some months ago. There is nothing of particular interest about the pathology of the goiter but the specimen is of interest because of its unusual size. I will not take the time to present the history of the case. The patient had a very large colloid goiter and it was removed under local anesthesia. The patient said she had no pain whatever. She left the hospital at her own request on the fifth day. Late a little infection developed in the wound and she came back, but otherwise had an uneventful recovery. Considering its size one might think it would be difficult to remove under local anesthesia but there is no difficulty whatever. I removed a goiter some time after which went down behind the clavicle practically to the arch of the aorta. It presented a very great difficulty in removal than this one despite the fact that it was not of large size.

I. PYLORIC OBSTRUCTION DUE TO THE INGESTION OF STRONG SULPHURIC ACID GAS TROPHENTEROSTOMY RECOVERY

Dr ALBERT L. HALSTEAD. I will show the roentgen films and report the case of a young man who suffered from a pyloric obstruction due to the ingestion of a considerable quantity (probably about four ounces) of commercial sulphuric acid. This accident occurred on November 7. He

entered the St. Luke's Hospital immediately and was given the routine treatment with usual antidotes for sulphuric acid poisoning. His condition was precarious for two days but he gradually improved and was taken home in a fairly good condition on the tenth day after the acid was taken. At the time he was permitted to take liquid nourishment. He vomited occasionally but most of the liquid taken were retained. Two weeks after returning home he had a severe gastric hemorrhage vomiting about 10 ounces of blood. The day following he had a second hemorrhage of about the same quantity. Ten days later he vomited about four ounces of pus. This was repeated on the day following.

Since about December 2 there has been no evidence that any of the food taken has passed the pylorus. He vomited daily all of the liquids taken at times with a considerable quantity of pus.

Fluoroscopic examination after the ingestion of a bismuth meal proved conclusively that nothing passed the pylorus. The roentgenogram taken at this stage of the disease shows as you can see that the stomach is represented by a shadow showing a blind pouch lying up corresponding to the cardiac end and the fundus of the normal organ.

The patient was operated upon on January 2. The stomach was found constricted below the fundus the constricting band passing from the lesser to the greater curvature and involving both

the anterior and posterior walls. The portion below this constriction was devoid of lumen and was represented by a hard fibrous mass which terminated at the pyloric ring. The lesser peritoneal cavity was explored and found to be obliterated by the inflammatory process which had destroyed the stomach. There was no chance offered to attach the intestine to the posterior wall so an anterior retrocolic gastro-enterostomy was performed the gut being attached high up close to the cardiac end.

The patient made a rapid recovery. Liquids were given in increasing quantity after 1 hour. At the end of a week he was ready to leave the hospital having gained 5 pounds in 5 days.

I will now show you the roentgenogram taken one week after the operation. You can see that the bismuth is passing freely into the small intestine through the gastro-enterostomy opening.

There are not many cases reported of pyloric obstruction from ingestion of caustic poisons.

In 1901 in the *Revue de Chirurgie* Quenu and Petit reported a case of hydrochloric acid poisoning in which after eight years a gastro-enterostomy became necessary. They reviewed the literature of this subject and found 33 cases besides their own in which obstruction of the pylorus had resulted from corrosive poisons. Three of these were from sulphuric acid. In one operated on by von Eiselsberg the patient had two strictures of the oesophagus along with obstruction of the pylorus. In three other cases it was necessary to treat strictures of the oesophagus which were present with the obstruction of the pylorus. In all the others no permanent lesions of the oesophagus were mentioned. The pyloric lesions were treated by pyloroplasty in all but seven cases. These were treated by gastro-enterostomy with five recoveries and two deaths.

In my case there appears to be no lesion of the oesophagus. His lips and mouth were burned but not deeply.

2 BENIGN BONE CYST PATHOLOGIC FRACTURE OF UPPER END OF HUMERUS INTRA-MEDULLARY BONE GRAFT

DR HALSTEAD This young man H. B. is 24 years of age. In September 1915 he sustained a fracture of the upper end of the shaft of the right humerus two inches below the head. The trauma causing the fracture was insignificant in going downstairs he was pushed against the balustrade without any considerable force and the bone was broken.

He was admitted to my service immediately after the accident. The X-ray of the fracture revealed a benign cyst of the bone at the seat of fracture. He gave a history of having been treated one year before for a fracture of the same bone at the same location. This fracture had been reduced and union was complete in about six weeks.

Owing to the fact that there was present a bone

cyst of considerable size causing unusual fragility of the bone an open operation was done. The cyst cavity which was the size of an English walnut was thoroughly curetted the medullary cavity of the shaft below and above the fracture was scraped with a sharp curette. A bone graft four and one half inches long was removed from the crest of the tibia and after shaping it to fit the medullary canal of the shaft it was driven just into the shaft below the fracture and then the upper fragment was forced down over the upper part of the graft. The graft fitted so snugly that after its insertion the arm could be handled as if no fracture had been present.

I will show you roentgenograms taken from time to time since the operation. These show clearly that the fracture is healed and that the cavity of the bone cyst is obliterated. They also show that there has been a gradual absorption of the bone graft which is indicated by the eroded appearance of the surface of the graft and by the less distinct outline. The last one taken yesterday shows only a faint outline of the graft which has materially lessened in diameter since it was introduced.

3 RESECTION OF THE UPPER HALF OF THE HUMERUS FOR SARCOMA (MEDULLARY) OF THE UPPER END BONE TRANSPLANT

DR HALSTEAD This young woman T. N. entered my service at the St. Luke's Hospital in July 1913. One year previously she was lucked by a horse and received a bruise of the right arm near the shoulder joint. Shortly afterward she began to experience pain. The arm became swollen and the pain and disability increased. Examination on July 9 the day of entrance in the hospital showed a spindle shaped enlargement of the upper end of the humerus. The arm was painful movement of the shoulder in any direction was impossible. A roentgenogram of the shoulder and humerus showed a medullary growth involving about 4 inches of the upper extremity of the humerus.

Operation July 14 1913. The humerus was exposed from the shoulder joint down to a point just below the middle of the bone a trifle less than one half of the bone including the upper extremity the ligaments of the shoulder joint and the articular surface of the glenoid cavity were removed.

A graft exceeding in length by one and a half inches the part resected was removed from the tibia. The graft was triangular in outline and was covered on two sides by periosteum. On one side it contained medullary tissue. One end was shaped so that it could be driven into the medullary canal of the remaining portion of the humerus for a distance of one and a half inches. The periosteum of the lower extremity of the graft having been pushed back was united to the periosteum of the lower end of the shaft of the humerus by catgut sutures. The upper end of the graft was rounded so as to form an articulating surface. This was

covered with fascia taken from the anterior chest wall near the shoulder. The posterior muscles as well as the pectoralis major were attached to the graft. The wound was closed and healed by primary union. The shoulder and arm were retained in a plaster cast for six weeks. After that passive and active movements were carried on until she left the hospital about the middle of September. Since leaving the hospital she had used the arm in her work without any pain or discomfort. The shoulder movements are about normal except abduction which is limited. She is able to abduct the arm only to a right angle as you can see.

DISCUSSION

DR D B IHEMISTER I believe that as time goes on the intramedullary graft will be gradually absorbed as the corticospinal part of the bone becomes stronger and the cystic condition heals. It is a matter of the internal architecture being reconstructed. After the corticohypertrophies and is sufficiently strong to support the shaft there is no reason for the continued existence of the intramedullary graft. It is a matter of functional adaptation. Nature makes every endeavor to restore conditions as they were not before the operation but before the disease set in. Take that last case the transformation of the transplant into a structure which resembles the upper end of the humerus. You can see that growing.

I recently had an opportunity to examine a transplant which consisted of the crest of the tibia which I inserted into the lower end of the ulna where I had made a synostosis. It is a much smaller

probably one third the size of the transplant which Dr Halstead used in this last case. Eight months after inserting the graft there was a small recurrence in the radius. I excised the recurrence a portion of the transplant and the end of the shaft because there was no union. I had a chance to study the transplant and it was remarkable to see the way in which it was transformed into bone with the medullary cavity. The piece of bone I put in consisted of the crest of the tibia. There was a definite medullary cavity and cortex in it and it was a circular line. I think the same thing is going on in Dr Halstead's case but it will take much longer to grow because of the size of the transplant and the size of the bone that will have to be formed to replace it.

DR VICTOR L SCHRAGER I would like to know the technique used in attaching the upper end of the transplant to the cavity whether there was any attachment or not and whether it was held in position by the muscles.

DR HALSTEAD I wrapped the posterior muscles around the bone graft and attached it by a catgut suture to the periosteum.

An interesting feature of the graft Dr Ihemister spoke about is that it is gradually growing less distinct. The difference between that graft and the one in the girl is quite apparent. The one in the young woman is just as large as it ever was and it is rounded off in the shape of the humerus. It shows no tendency to disappear whatever. The function of the arm and movement of the arm require that it be kept there. The other graft is no longer required. As soon as the bone heals that probably will disappear.

CHICAGO SURGICAL SOCIETY

REGULAR MEETING HELD JANUARY 4 1918 WITH THE PRESIDENT DR CARL BECK
IN THE CHAIR

SUTURELESS SKIN SLIDING METHOD FOR THE RADICAL TREATMENT OF LUNG ABSCESS AND CHRONIC OSTEOMYELITIS

DR EMIL G BECK read a paper entitled
Sutureless Skin Sliding Method for the Radical
Treatment of Lung Abscess and Chronic Osteo-
myelitis (See p 259)

DISCUSSION

DR E WYLLIS ANDREWS Dr Beck has given us a very interesting and instructive presentation on this subject and one might think from seeing the pictures that this was only a mechanical problem in the sliding flap method. Perhaps there is nothing gained by turning points of skin flaps inward over leaving a bridge of skin but apparently we are dealing here with a principle of surgery which we see

illustrated in all kinds of skin grafting namely if one can approximate epithelial surfaces to growing or living surfaces the stimulating or regenerative action from the margins of the epithelial surface act very soon and proliferate and close over areas more quickly. We see in the method old fashioned reverdin grafts scattered like islands over the surface and from the presence of these implanted epithelium rapid stimulation and epithelialization. That seems to be the secret of Dr Beck's success. Other use one might say we cannot gain anything in point of time or in the quality of healing by merely sewing points of flaps in because the skin can be made to sink in and the cavity collapse as completely by the older Erstlaender or Schede operations.

DR JAMES M NEFF I would like to ask Dr Beck what he does with the areas left after taking

these large flaps whether he skin grafts or not how these surfaces contract and how rapidly

DR DANIEL N EISENDRATH There is one point I would like to emphasize in connection with the X ray and that is that the stereoscopic X ray has superseded practically every method of diagnosis

I want to show some lantern slides illustrating points in the differential diagnosis of some of these thoracic lesions

This slide illustrates beautifully the difference in density of the shadow between a serous effusion and a bloody effusion Oftentimes it is necessary especially after an injury to say whether we are dealing with a serous effusion or a bloody effusion In the lung it does not make much difference Unless pressure upon the heart supervenes the thorax will take care of itself

The next slide shows the lesser density of a serous effusion and a transverse line of dullness The heart is not displaced at all and the lung appears compressed

The next picture which was taken with the patient in a horizontal position shows that the fluid is movable which confirms the diagnosis of a nonencapsulated fluid as distinguished from an encapsulated empyema The surface of the fluid is at right angles to the diaphragm instead of being parallel to the diaphragm

The next picture shows a difference in density of the blood because the shadow is absolutely opaque This was a stab wound of the abdomen with an extensive contusion of the thorax with an enormous hemothorax on the left side which displaced the heart to the right and had to be aspirated to save life

The next is a picture of an abscess in the posterior half of the lower lobe of the left lung and in the posterior half of the upper lobe of the left lung It shows a circumscribed shadow distinct from an empyema or even a serous effusion On the left side there was a lung abscess following tonsillectomy which finally yielded to the injection of bismuth paste after resection of the ribs had proven of no avail

This next picture is a beautiful example of a shadow which might be taken for an abscess of the lung An abscess of the lung seldom will if ever give rise to such a dense shadow This was an endothelioma of the pleura a circumscribed mass due to this tumor

I want especially to recommend something which Dr Beck did not emphasize and that is the value of the surgeon himself going into the X ray room and studying shadows himself under the fluoroscope watching the movements of the diaphragm and noting the influence which changes in position will have upon the fluid in the chest The X ray in my experience has superseded for our surgical purpose every other method of diagnosis

DR CARL BECK In the first case that you saw my brother pointed out that gradually the tissues

pushed the flap out and slowly obliterated the cavity so that the skin flap came more to the surface You noticed that in most of the pictures There is an important lesson in this when we study recent war pictures

I have been much interested in plastic work and in studying pictures of cases without intentionally doing the same thing surgeons have had to promote this healing with skin flaps Wounds of the face in this war are very ragged The skin forms flaps by the injury and these flaps turn inward as the wound which is treated is an open wound at first As all surgeons know the open wound treatment whether you irrigate or not is the best treatment This treatment opens all recesses of the wound and allows the discharge of secretions Gradually the flaps turn inward and the result is a disfigurement of the face That is the picture which comes to the plastic surgeon afterwards These scars of the flaps healing to the bone remain unsightly if not subjected to a plastic operation When these war wounds have held retracted skin flaps toward the bone and formed these irregular deep scars in the face which often show deep retractions clear down to the upper jaw the plastic surgeon has to retrace the steps of wound healing he has to resect every vestige of the scar and if there is no infection to bring together the healthy surfaces and healthy muscles and healthy fascia and after he has united all he brings together the borders of the epidermis over this elevated portion making a good plastic effect and obliterating all the defects and scars That is what I call scar elimination The same thing has been reported by others who have worked along this line resecting the scars gradually bringing the normal tissues in their normal position Thus we obliterate cavities and bring the skin together so that the deeply retracted scars of the cheeks fill out If there is bone fat or cartilage missing it has to be transplanted and implanted and we get plastic results which obliterate these defective scars

DR EMIL G BECK (closing) We use adhesive plaster strips which adhere like a postage stamp along the border covering the junction of the skin and the granulating surface This gives a sort of leading surface along which epithelial cells grow It is remarkable with what rapidity skin grows from the sides often covering surfaces as large as my hand After removal of a breast I left a surface as large as my hand denuded and it gradually healed over with normal skin

The adhesive plaster method I learned from the dressing of wounds of burns One of our ex-interns treated a great many electric burns in that way I watched his cases and saw surfaces ten inches long and four inches wide epidermized by that method and so I adopted it for this new purpose

In reply to Dr Neff I do not decri skin grafting because I know some excellent results have been obtained from it and I occasionally resort to it

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS IN GYNECOLOGY AND OBSTETRICS

B. GEORGE GELLHORN, M.D., F.A.C.S., S. Louis

TO av mor of a n w d t n of the *Obstetrics* by Williams than that has appeared in print would smilke ca vng colit N. astle. L v ry on kno s that this is a cla ic n ob tet i s nd that it is one of th most worth while book Ame can lite ature may boast f. The fou th d t ion has been thoroughly revied and the advan es mad n obst tr s n the past f e yea ha e e d e d a slight ncrease in si e unavo datl. The m n textual hnges co r th foil g ubjects anatomical ha gcs du ng me truation placenta t on metalohsm of pegancy nd puerperium. Abderhalden s preg a cy rea t on chnges in the ndoc in gla d olstet cal anæsthe ia cesarean s ction the relation f vphits to th gen rative proc ss etiology a d treatme t of ab rtion nd prematur lab the ue of pitu tr n t ansve se p clnta o and p matu e sepa at on of the placenta

One of the re s r fri nds makes it hi custom to read h s W illam from cover to cover one a yea. If this cellent habit were emulated by many p acitione s the standa ds of ob tetric al p actice in th s country would r se at once a d be come the mod l for oth nation

IT is ne thing to read w th plea ur and profit th the imfos g tome v h l constitute *The New System of Gynecology* by Eden and Lockyer a d quite another to rite in the few columns allotted to book ews a synop s v hich would d adequate justice to this p etentious w rk. There is h e ve little need to go into such deta l for the gy cologists of this or any other Eng sh speaking on try v ll be only too eager to add these volum to the librare and to enjoy to themselves this r markable collection of monograph. Eden and Lockyer v ho have qu t r cently b ought out an c ll nt textbook on gynecology for stud nts and p c titioners have de p te the t ubled times succeeded in as emblng 57 of the ablest gynecolo gists of G t Britan the United States nd Canada. Th names of many of the contributors are familiar to us and carry vith them a guarantee

of substantial scie tific food. And the e are nu merous the s younger ones h as they reveal th mselve n thes pages promise a hopeful out l ok for the future of our specialty. Of our own countrym n v e g eet our friends Ho ard C Taylor f Ne Yo k and Franklin H. Martin of Chicago

The g neral plan of the ork n be best stated in the f llo ng pa graph taken f om the preface

Gynecology ha becom definit ly a p cial branch of surgery in close touch th abdominal surgery gene ally and the old view that the gynecologi t is a phy cian not a surgeon is no longer tenable. In c nsequence of this de clopment the interests of the gynecologist ha e neces arily broadened. Pelvic disease in omen is frequently ass ciated in the elation of cause or of effect w th diseases of the gast o intestinal and urinary canals. the gynecol gist h s acco dingly realized that he must be prepared to deal vith hatever condition he may find on op ning th abdomen for the relief of di ase apparently of pel c origin. And further he ust be fam liar w th the special methods which are empl ved in the in stiguation of such diseases as those of the kidneys the bladder and the rectum. Di ases of the female breast fall so ob ously into the p oince of the gynecologist that no planat on of the inclusion of this subject is called for. Th vermifo m appendix possesses relationships of unique intimacy with the pelvic organs and th re s no doubt that cases of appendicitis in women very frequently come under the care of the gynecol gist. During pelvc operations m j nes to the inte t nes n cessitat ng entero raphy or ente ctomy frequently oc ur with wh ch t is quite ob ous that he must be prepa ed to deal. And fu ther during convalescence from bdominal ope tions ntestinal complicat ons may an e v hich call for a sound know ledge of inte tinal s r ge y

Volume I deals with gy eclogy in gene al a d cont n s a ticles on a tomy physiology method of exam nation diso de of function malf rmat o s and th a ous type f ufection (cptic g n hocal tube cular vphilitic) tr v l me II treat of the affectio s of the va us repr d ct e organ and Volume III is de ot d to gyn c log therapy ope at e and the sc

Nor s the f te la d of gyn col gy negl t d and e finl in these lum s ticles on e vo s d sord rs asso ted th morbid conditons of the

O rs By T W dg Williams MD h d N w Y L d
L D A I & C
Ed M D F R C S F I C P d C h b Lo Ly M D H S
F R C S F R C P I Lo d d N w Y L Th Macmill
C m p y

pelvic organs in women on diseases of the breast the appendix and rectum on hernia and bladder and on general complications in gynecologic surgery

How bare this brief summary appears in comparison with the wealth of material offered to us! Some of these articles are real gems. Take for instance Chipman's chapter on backward displacements of the uterus and enjoy to the fullest the virile style the lucidity of thought the skill of exposition even though you may miss here and there a point in symptomatology diagnosis or therapy which seems of importance to you. In so large a collection of monographs not all contributions can reasonably be expected to be of equal value yet by far the greatest number deserve unstinted praise.

The work does not consider in detail the entire literature of the world and thus is not as encyclopedic as its older competitor Veit's *Handbuch der Gynaekologie* but there is no lack of thoroughness and there is a personal tone in it which is immensely attractive. It is as if you were comparing notes with another gynecologist whose views you may not share in every particular yet whose opinions you always hold in high respect. For this is a work not written for the student or novice in gynecologic practice but for the man who has already won his spurs and therefore has learned to read critically and appreciates even more the opportunity to commune and to debate with a number of his fellows. It seems an ideal way to get into close touch with practically the entire gynecologic profession of two countries. The energy and wide vision of the editors and the munificence of the publisher in the way of beautiful and abundant illustrations and attractive make up deserve the warmest commendation.

THE second edition of De Normandie's book¹ has appeared in a surprisingly short time. The words of warm recommendation with which we greeted the first edition² are equally applicable today. These case histories represent the methods of bedside teaching in book form. The work is divided into twenty-eight sections. Each section deals with one of the normal or abnormal conditions which the obstetrician encounters in his work. A few of the headings may serve as illustrations. Miscarriage normal pregnancy prolapsed cord contracted pelvis nausea and vomiting of pregnancy face presentation ptychitis mastitis heart disease in pregnancy. Several chapters are devoted to technique of and indications for certain therapeutic measures such as forceps version scopolamine and morphine anesthesia. Each section that is each subject is composed of one or more case reports taken from actual and personal practice and a summary in which the

author introduces important points in diagnosis prognosis and therapy.

A wise pedagogue once remarked. The best teacher is he who does not seem to teach. This applies exceedingly well to the book before us. It is written in the lightest conversational style. One can imagine the author not in a class room teaching the principles of obstetrics but at the bedside recounting to a group of students the experience he has had with this particular patient or reporting among a few fellow practitioners the interesting features of a special case. And in the form they are presented to us all these cases are interesting from a normal left occipito anterior delivery to a premature separation of the placenta or an incomplete rupture of the uterus.

The work does not aim to usurp the place of a textbook on obstetrics but it supplements the functions of the latter in a most felicitous manner. To the student it serves as a repertory of what he has learned in lecture room and clinic and to the man in active practice it may often take the place of a consultant when such a one is not available. In any case it will stimulate the reader to attain a higher standard in his obstetric work.

IF you have heretofore associated in your minds the term *Handbook* with an extensive work of one or more bulky tomes the most recent *handbook of gynecology*³ will quickly undeceive you. In a slender volume of a little more than 400 pages the authors have understood how to condense all that the third and fourth year medical students as well as the young practitioner should and must know of the essentials of gynecology. To accomplish their object within a limited space the authors have exercised a wise and most commendable restraint. They have realized that as far as the medical student is concerned gynecology ranks in importance after medicine surgery and obstetrics and in consequence they have omitted all mooted questions theoretical considerations and long descriptions of major operations and their technique. Their desire to be brief has however not led them to a dry compendial enumeration. There is on the contrary a consistent effort noticeable to keep in view the prime importance of interpreting morbid objective data and to trace the relationship between pathologic cause and physical effect. In this connection the chapter on gonorrhoea may be mentioned as particularly praiseworthy. The original illustrations are quite instructive those adopted from other sources are well selected.

That a book of the character indicated is dogmatic in its expressions is perfectly natural. We would earnestly wish that all medical students might absorb the teachings presented by Lewis and de Roulet. There is very little one might possibly object to. The unreserved recommendation of

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nitrous oxide anæsthesia may be cited as an example. Is it really true that this form of anæsthesia has thus far caused only one solitary death? In describing in detail and illustrating the operations for vesicovaginal fistula and of supravaginal amputation of the uterus the authors have not been quite consistent. It would have been preferred to see the operation of curettage more fully illustrated and more thoroughly described.

But such imperfections are too insignificant to detract from the value of the book. It seems to us that in addition to students and young practitioners many gynecological teachers will be glad to avail themselves of its advantages as a basis for their lectures.

It seems hardly necessary to explain why a book on veterinary obstetrics should be recorded in these columns which are devoted to works on human pathology. The biologist, the physiologist, the teacher of obstetrics, the research worker will quickly vote for the legitimacy of such procedure. By far the greater part of our knowledge of the science of human obstetrics is based upon observations of animals and there are yet many important problems waiting their solution through animal experimentation. The relationship between ovulation and menstruation which has caused so much confusion and controversy has only recently been cleared up by Fraenkel through studies upon animals. The remarkable observations by Leo Loeb of parthenogenetical processes in the ovaries of guinea pigs with their bearing upon the formation of teratomata calls for investigations on other and larger animals. The cryptoleum question and its direct application to the human is intimately connected with veterinary obstetrics and the list of points of contact between the sciences of human and veterinary obstetrics can easily be extended.

There has been until now a need for a truly scientific book on veterinary obstetrics and we are indebted to the author for presenting to us his work which will prove of great value to the men engaged in comparative studies. The clinician too will find much that is of interest and he cannot but be impressed by the abundance of material adduced.

THE rapid strides in laboratory methods make it imperative for the progressive physician to keep abreast of the advances made. A textbook on this subject should not only indicate the proper technique of the methods of laboratory diagnosis but should also emphasize the relative value of the procedures and the practical importance of the knowledge so obtained. This object has been eminently well achieved by Wood in his *Chemical and Microscopical Diagnosis*. The facts obtained in the laboratory says the author may occasionally be of more value than those secured by the physical examination of the patient; they more often possess a corroborative force ranking with the observations procured by the stethoscope and eye; occasionally they have merely a scientific worth and are relatively unimportant from a point of view of an immediate diagnosis.

The experience of the distinguished writer in hospital work and teaching of clinical pathology has enabled him to present to students, hospital interns and practitioners in an authoritative way, the microscopical and chemical examination of the blood and the secretions and excretions of the body. In the third edition which has recently appeared several additions and alterations have been made notably the technique of the Wassermann reaction and the preparation of vaccines, the antiformin method of concentration, tubercle bacilli in sputum, functional tests of the activity of the gastrointestinal tract and hæmolytic tests.

A work of such intrinsic value hardly requires commendation — it recommends itself.

Obstetrics. By William L. Williams, M.D., Professor of Obstetrics, University of Chicago. 1913. 128 pp. \$1.50.

Wood M.D. 3d ed. N.Y. K. D.L. d. D. Appl. & C.

AMERICAN COLLEGE OF SURGEONS

ADMISSION TO FELLOWSHIP

REVISED requirements for admission to Fellowship in the American College of Surgeons have just been issued by the College. This pamphlet is a revision of Bulletin No. 1 and contains some changes over the original bulletin which have grown out of the experience of the College during the past four years. Explanation of the more important of these changes is given here in the Journal. But the interesting feature of this new bulletin really lies in things not explicitly written in it and this feature therefore is here first emphasized.

The requirements for admission to Fellowship in the College are a clear cut standard in surgery which has to do both with scientific attainments and with character. That standard has proved itself to be workable and practicable. It is a test of surgical efficiency and as such reaches to the very roots of the profession. It is one of the forces today which makes for the standardization of the profession. The fact is that surgery can not be far disengaged from general medicine. Medicine is a single science. Every doctor is in some measure a surgeon and if surgery or any branch of the science of medicine makes progress the effect is to draw with it all other divisions of the science.

But the advance of surgery as indicated by the regulations of the College is still further related to the standardization of the profession. It is linked with and inseparable from the standardization of hospitals which is very direct standardization of the profession. And still more important it is inseparable from the greatest of all standardizing agencies which in these rugged times are the offices of the Surgeons General in Washington where the medical activity of the Army of the Navy and of the Bureau of Public Health is controlled. From these

centers with speed never before approached in the history of medicine has come standardization of medicine and surgery and of all that makes for health. Standardization of case records of physical examinations of laboratory routine of medical and surgical procedures of sanitary measures standardization which is the straightest thinking of the strongest minds in the profession have all found quick application in our vast military service. The war has cut us loose from medical limitations of the past to which we can never go back.

This momentum of the government toward medical efficiency has not perhaps reached the folk in the far-places of the country. But that it will reach these people in the near future and all the rest of us no one can doubt. With millions of men trained in government service which service includes insight into modern medical efficiency, we need not expect these men on their return home to accept a lower standard of medicine for themselves for their families or for their friends. They will demand and have standardization.

But when the soldiers return to their homes what reliable standard in medical matters will they have? Naturally they will ask the profession itself first for its credentials. What credentials does the profession have? The polite fiction that a medical diploma and a license to practice medicine are evidence of fitness is not enough. But the profession itself is quite capable of producing satisfactory credentials. It can itself set up a standard and enforce that standard without fear and that is exactly what the profession has done through the American College of Surgeons in so far as the specialties of surgery are concerned. The College is the standardization of surgery. Its requirements for

admission to Fellowship are not only a standard of surgery recognized throughout this continent by the profession but they constitute also a standard which with increasing rapidity the general public accepts. The standard of the College is further accessible to the public because the College publishes annually a year book in which are listed the names of those surgeons who are qualified. This year book is distributed to the Fellows of the College to hospitals libraries clubs etc. It is a directory of surgeons of the United States and Canada who are competent.

The College as a factor in the medical profession has now passed through its period of trial. The responsibility that it be fearless and just in its administration daily increases. It says in effect to all specialists in surgery: We want you with us. But we ask your initiative in making application for Fellowship and we ask evidence also that you are honestly qualified for Fellowship. Application blanks may be had on request from the College.

The College greatly appreciates suggestions from its Fellows from other doctors and from hospital superintendents as to names of surgeons who are considered right material for Fellowship. Especially the College desires the names of surgeons who were graduated less than eight years ago and who are therefore at this time not eligible to Fellowship. It desires to keep in touch with the careers of these men and from time to time to send them bulletins of the College which have to do with the progress of surgery.

CREDENTIALS IN OPHTHALMOLOGY

One important change in the requirements for admission to Fellowship affects the ophthalmologists. This change is stated in Article 10. As explained later in these pages, case records offer an effective check upon the qualifications of a candidate in general surgery. But as a test of the surgical judgment and of the training of eye specialists the case records have proved of less value. In co-operation therefore with the American Board for Ophthalmic Examinations the new plan is worked out. In this period of trial for the

new requirements the American Board and the Ophthalmic Credentials Committee of the College are one and the same body. The personnel of the committee is Dr. Edward Jackson, Denver; Dr. Frank C. Todd, Minneapolis; Dr. William H. Wilder, Chicago; Dr. Edward C. Ellett, Memphis; Dr. Walter B. Lancaster, Boston; Dr. Hiram Woods, Baltimore; and Dr. Myles Standish, Boston; Dr. John E. Weeks, New York.

REQUIREMENTS FOR ADMISSION TO FELLOWSHIP

1. The candidate shall be a graduate of medicine, licensed to practice medicine in his respective state or province or accepted as a medical officer in the service of his country.

To be eligible for Fellowship without technical examination the candidate shall be a graduate of a medical school approved by the American College of Surgeons. If the candidate's school of graduation is not accredited by the American College of Surgeons, he may be required to pass a technical examination in one or all subjects of the medical curriculum.

3. The candidate shall give evidence that he has served at least one year as an interne in a creditable hospital and two years as a surgical assistant or he shall give evidence of an apprenticeship of equivalent value. Five to eight years after graduation in medicine devoted to special training and to practice are normally the time requirement for eligibility to Fellowship. Due importance is attached to laboratory and research work.

4. The ethical fitness and integrity of the candidate and his professional attainments shall be passed upon by the Credential Committee of his state or province before he is entitled to take the examinations for admission to Fellowship as hereinafter described. To aid the Committee in this work the Fellows of the College are asked from time to time for definite and impersonal reports concerning candidates in their respective states and provinces.

5. The professional activity of the candidate shall be limited to the study, diagnosis and operative work in such specialty or specialties of surgery as the candidate may himself designate as follows. First, if the

candidate resides in a city of less than fifty thousand inhabitants at least fifty per cent of his professional activity shall be limited to the study diagnosis and operative work in such specialty or specialties as stated. Second in cities of over fifty thousand inhabitants at least eighty per cent of the professional activity of the candidate shall be so limited.

6 The candidate shall make formal application for Fellowship. Blank forms for this purpose may be had upon request from the Secretary General of the College.

7 In making application for Fellowship the candidate shall sign a declaration which reads as follows:

I hereby promise upon my honor as a gentleman that I will not so long as I am a Fellow of the American College of Surgeons practice division of fees in any form neither by collecting fees for others referring patients to me nor by permitting them to collect my fees for me nor will I make joint fees with physicians or surgeons referring patients to me for operation or consultation neither will I in any way directly or indirectly compensate any one referring patients to me nor will I utilize any man as an assistant as a subterfuge for this purpose.

8 Surgeons widely recognized by the profession as leaders of progress and exponents of finished technique by a unanimous vote of the Board of Regents may be admitted to Fellowship on recommendation of the Committee on Examinations. Personal candidature for Fellowship on this basis however is not entertained. All candidates for Fellowship are requested to make formal application as described under Articles 6 and 7.

9 The examination in the art and technique of surgery consists of first fifty complete case records to be submitted by the candidate of major work performed by himself second fifty case records in brief abstract of major work for which he was responsible or in which he acted as assistant. For requirements in ophthalmology see Article 10.

In order that this requirement be more explicit the College has prepared a series of record forms which indicate in a general man-

ner the data desired in so far as they are applicable to each case and the form within reasonable limits in which these data should be submitted.

The essential data for the fifty complete case records are the identification of the case by number—the name need not be given date of operation personal history relevant to complaint diagnosis on which operation was based operative record findings at operation and technique laboratory and physical findings postoperative diagnosis complications of convalescence follow up record in so far as available. A summary of each case as explained later is also desired. The essential data for the fifty case records in abstract are the identification of the case by number date of operation and brief statement of operation.

10 In addition to the general requirements for admission to Fellowship (except Article 9) the examinations in ophthalmology consists of first case records second written examinations and third clinical laboratory and oral examinations or so much thereof as may be judged necessary.

a Candidates in ophthalmology are required to submit twenty five complete case records in accordance with Article 9. Ten of these records should be of cases of ocular diseases and defects of varied character including errors of refraction or muscle balance external ocular diseases or diseases of the uveal tract or retina or of the optic nerve or glaucoma. The reports should show especially the reasons for the diagnosis and for the operative treatment and the technique of operations.

b The written examination will test the candidates knowledge of the underlying principles or science of ophthalmology including anatomy embryology physiology physiologic optics pathology relations of the eye to other organs and diseases of the body.

c The oral examination will include

1 The external examination of the eye

2 Ophthalmoscopy (Candidates are requested to bring their own ophthalmoscopes)

3 Measurements of errors of refraction

4 Testing of the ocular movements and fields of vision

cases are successfully treated and if not why not. Case records are the basis for such critical reviews.

But the case records although accurately kept are frequently not available for review because the important information in them for this purpose is lost in other details. It is recommended therefore that leading facts in each case be recorded upon a summary card. Such a summary card is here suggested. For convenience the card should be about 5 by 8 inches.

For the details of this card and for insistence upon its value in medical and surgical efficiency the College is indebted to Dr. E. A. Codman of Boston. Some explanation of headings of the card is here given.

Diagnosis on which treatment was based. A physician or surgeon who treats a patient should be willing to state what pathologic condition he believes he is treating. Both the profession and the public realize that in clinical work it is often impossible to be certain that the working diagnosis is correct. With the best of equipment and of medical knowledge diagnoses are frequently incorrect in some details but when a doctor accepts the responsibility of treatment he is in fairness to the profession and to his patient under obligation to state what he believes is the cause of the illness for which the patient seeks relief. If the cause of the illness cannot be determined the physician or surgeon responsible should at least state that fact.

Physician or surgeon responsible for treatment. If one physician or surgeon only is concerned in a case it is clear that he is responsible. But in modern hospital practice it frequently happens that the responsibility is divided among many individuals. The profession is agreed however that in a properly conducted hospital either the chief of the service or one of his subordinates should hold the same position of responsibility toward the patient as does his family physician. When

the responsibility is multiple a physician or surgeon should be assigned to the patient who sees him through the care of other specialists and the name of this physician or surgeon should be entered upon the case record.

Important points of operation or of treatment. Under this heading the physician or surgeon responsible should note only the essential points. He should write down the points which he may wish to know a year later if the patient returns to report his condition. If the operation or treatment is very complicated notation may be a difficult complicated operation described in detail in main record.

Complications of convalescence. This heading is most important for efficiency studies. If the word 'none' follows the heading it means that there were literally no complications such as sepsis, bronchitis, cystitis, phlebitis, intercurrent infections or other conditions resulting directly from the treatment or operation or following it from other causes.

Pathologic report. So much of the various pathologic reports as would be important for the person who examines the case a year later to know should be entered under this heading. It is not expected to be a complete statement of the pathology but merely the main pathologic diagnosis.

Postoperative or final diagnosis. The record here entered is quite essential to an analysis of the efficiency of the work done in the hospital.

On the reverse side of the card should be entered notes of the case made at subsequent visits of the patient or from subsequent reports as to the condition of the patient. These notes should be brief, accurate and fearlessly truthful. In general the notes under the different headings should be made with the idea that they are available for rapid review. Wherever details are important and yet too extensive to be placed on the card reference should be made to the main record.

SURGERY, GYNECOLOGY AND OBSTETRICS

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CANCER OF THE STOMACH¹

By WILLIAM J MAYO M D ROCHESTER MINNESOTA

MORE than thirty per cent of all cancers in civilized man are in the stomach. Why should there be such an enormous percentage of cancers of the stomach? This manifestation of malignant disease is uncommon in lower animals and primitive man yet there is comparatively no essential secretory or mechanical difference in the function or structure of the stomach. It has been suggested that the disease is connected with the formation of an acid secretion. As far as I know no gland in the human body secretes an acid. In the colon the acidity is not a secretion of the mucous membrane but is due to bacterial action. The kidney has no true secretion it is a filter from which acid forming bodies are excreted. The stomach does not secrete acid the material for the formation of acid is brought together on the surface of the mucous membrane and the acid is formed not within but outside of the glands. Acidity of secretion and changes incident to disturbed storage function may be contributory factors but evidently they are not the responsible agents.

Does the cause concern food or drink? The difference in the nature of the food and drink of lower animals primitive man and civilized man is not sufficiently great to lead to the belief that food or drink of themselves could be looked upon as the important factors.

May it not be some process to which civilized man subjects food or his manner of

partaking it that is the exciting agent? The only known fact regarding the causation of cancer is the influence of chronic irritation on its production. Whenever cancer exists in one species of animal or race of men in an enormous excess of what occurs in other animals or other races of men it has been found to be owing to a single cause. Were there many causes some would be operative among all.

The relation of chronic irritation to the more familiar forms of cancer is an interesting study. For instance I have been able to find some evidence that cancer of the breast was an extremely rare disease in all races of people in whom the entire breast was left uncovered and exposed to the air and that the frequency of this manifestation of malignancy was in proportion to the covering of the breast and the pressure exerted by the covering.

The theory that the frequency of cancer of the stomach in civilized man is the result of hot food and drinks which act to cause chronic irritation of the gastric mucosa is worthy of consideration. The infrequency of malignant disease of the stomach in animals and primitive man would then be explained by the fact that they take their food and drinks cold. At the general meeting of the American Medical Association in 1915 I called attention to the possibility that hot drinks might be the exciting agent and

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during the past two years further investigation of the circumstantial evidence related to the facts leads me to believe that it may be one if not the main cause of the tissue changes which precede cancer of the stomach.

Why should cancer of the stomach be more frequent in the male (38 per cent) than in the female (22 per cent)? A possible answer to this question is furnished in the frequency of cancer of the posterior wall of the pharynx and upper gullet in Chinese men who are served first while the rice is hot the women eat at the second table when the rice is cold and rarely have cancer in this region. It is the social custom of modern civilization for the lady of the house to serve the beverages—herself last.

That heat has a remarkable influence in the production of chronic irritation has been known from the beginning of observations on cancers. Smokers' cancer of the lip for obvious reasons is almost confined to the male sex. The Kangri burn cancer of the Kashmir natives comprises more than half of the cancers of this race. They carry a clay charcoal burner in a wicker basket across the lower abdomen when they go into the mountains and as a result have heat irritation which acts to cause cancer of the lower abdomen and groins.

Here again the disease is largely among men because they are most frequently subjected to this form of tissue insult. Locomotive engineers who are for years subjected to the prolonged heat of the fire box have cancer of the shins arising from chronic heat irritation. Cancer of the skin of the face which occurs so frequently among Australians that it is often called the Australian disease begins in a peculiar climatic heat irritation.

A high percentage of persons take their drinks hotter than can be borne comfortably in the mouth. It has been shown by X-ray workers that when the stomach contains much food and drinks are taken these drinks are not carried directly into the cavity of the stomach but by a peculiar muscular contraction a canal (canaliculus gastricus) is formed in the lesser curvature along which the fluids are rapidly passed into the duodenum. Lightly five per cent of all cancers and

ulcers of the stomach involve the lesser curvature and they may have a common cause. The mouth and gullet are protected by pavement epithelium and possess sensitive nerves which give warning of injury the stomach has no such protection.

Newer and better methods of diagnosis within the past few years have greatly extended operability and made possible radical procedures in an increasing number of patients. The early diagnosis of cancer of the stomach depends on the roentgen examination. Carman has shown that cancer of the stomach may be demonstrated in 95 per cent of cases in this way by the time they give sufficient evidence of their presence to call the patient's attention to the fact that something is wrong. Every person in whom there is suspicion of cancer of the stomach should be promptly subjected to examination by the roentgen ray. All persons with an anemia which cannot be otherwise explained should be subjected to such examination. Cancer of the body of the stomach and cancer of the cæcum and ascending colon may produce striking anemias early before there are local symptoms.

Mechanical conditions arising from the frequency with which the disease originates in the pyloric end of the stomach is a fortunate occurrence and leads to early diagnosis. The presence of a movable tumor in this situation even of considerable size is a favorable indication and not as it is so frequently looked upon a sign of inoperability. If the cancer as it appears in the stomach is mechanically removable even if all the glands and indurated tissue cannot be removed I believe resection is still advisable. The mortality will be very little higher than after gastroenterostomy, palliation will be many times greater and occasionally a patient will be cured. I have never forgotten a lesson learned from a search of our statistics on gastroenterostomy for the palliation of clinically inoperable cancer of the stomach in which a section had not been removed for microscopic examination. Five of the patients thus operated on lived more than five years showing that a clinical diagnosis of inoperable cancer is open to error.

Chronic ulcer of the stomach is not often cured medically and I am convinced it is a potential source of gastric cancer. We can not question the fact that in the past many patients have been treated for the diagnosis of ulcer not for the disease. When ulcer is shown in the roentgenograms other things being equal it should be removed by actual excision and gastro enterostomy which gives a mortality of about 5 per cent or better after the removal of tissue for microscopic examination by frozen section the ulcer should be burned out with the cautery after the method of Balfour¹ and followed by gastro enterostomy. There were but two deaths in 198 operations by the latter method (a mortality of about 1 per cent).

In cases of cancer of the pylorus resection by the second method of Billroth leaves little to be desired. For cancerous ulcers high up on the body of the stomach occasionally a resection in continuity (segmental resection) may be indicated but for cancer of the pyloric end of the stomach and lesser curvature which constitute the great majority of cases wide removal followed by closure of the end of the duodenum and direct anastomosis between the cut end of the stomach and the side of the jejunum—antecolic—is the operation of choice. This method extends operability and enables the speedy removal of growths which would not be operable by any other method with which I am acquainted. On a number of occasions the operation has been completed in less than forty minutes.

The posterior end to side operation as first described and practiced did not produce better operative mortality statistics than the Billroth II but it did increase operability. The cause of the mortality in the posterior method (end of the stomach with the side of the jejunum) concerned the transverse colon and transverse mesocolon. It was difficult to consume time and occasionally it was impossible to fasten the anastomosed area below the opening in the transverse mesocolon. If this was not done the mechanical conditions often proved unsatisfactory. By the ante-

colic method a length of jejunum sufficient for a free loop (16 to 18 inches) is passed around the omentum and transverse colon and easily brought to the gastric stump for anastomosis. By this method it was found possible to reach a point for section still higher on the stomach than by any previous method and the mortality dropped from 13.2 per cent average to 6 per cent in an equally advanced or even more advanced group of cases.

Some of the operations in our series were very extensive. In nine cases the resections were subtotal that is the whole of the stomach was removed except just enough to enable an anastomosis to be made. In one instance I removed the entire stomach by the Moynihan method and with it a margin of the œsophagus. The patient made an excellent recovery and has surprisingly good function.

What results may be expected from radical operations for cancer of the stomach? We have eliminated all resections of the stomach made previous to 1897 as up to that time a specimen was not regularly subjected to microscopic examination. Taking the twenty years from October 10, 1897 to October 10, 1917 there were 651 resections of the stomach for cancer. Of 427 patients operated on more than three years ago who recovered from the operation 311 have been traced 120 (38.6 per cent) were alive three years or more after operation. Of 313 patients who were operated on more than five years ago 239 who recovered from the operation were traced and 62 (26 per cent) of these were alive five years or more after operation. In compiling these statistics we have assumed that the deaths which occurred were from recurrence of cancer. This assumption is unwarranted as the Medico Actuarial Mortality Investigation Tables show a normal death rate at the average age of these patients (5 years) of 4.2 per cent for a three year period and 7.5 per cent for a five year period. These percentages so far as the cure of cancer is concerned could be fairly subtracted from the death rate and would add by so much to the percentage of cures. It has been our experience that the patients we have not been able to trace following operation and whose ultimate

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condition has been ascertained in after years have shown a higher than average percentage of cures. No special effort was made to trace patients after the five year period but incidentally it was learned that 35 lived 6 years or more after operation 27 lived 7 years or more 18 lived 8 years or more ten lived 9 years or more 7 lived 10 years

or more 5 lived 11 years or more 3 lived 12 years or more and one lived more than 15 years after operation. These statistics of actual cures compare favorably with those of cancer in other parts of the body and show that the radical treatment of cancer of the stomach is keeping pace with the modern treatment of cancer in general.

CANCER OF THE STOMACH

By ALBERT J. OCHSNER M.D. CHICAGO

THE paper which you have just heard contains two of the characteristics with which you are familiar from your knowledge of Dr. Mayo's writings. The first of these characteristics has been of enormous benefit to the surgical profession not only of this country but of the entire world. The paper contains something that every one of you who is a surgeon can take home and make use of something that he can apply for the benefit of his own patients. It has practical value.

It also contains something that will cause you to think and to review the work that you have done and think over the patients you have seen and the observations that you have made. It gives you something to meditate over. It has value from the standpoint of inspiration.

You are impressed with the fact that a condition to which every one is exposed is an important matter to consider in studying the causes of this most fatal of all diseases.

We have known for a long time that there is no superficial cancer whether it be within the cavities of the body or upon the surface which occurs without preliminary irritation. We know that this preliminary irritation gives rise to disturbed circulation. We suppose that this condition of disturbed circulation gives rise to a pathological condition either directly as most of the authorities hold who are supposed to know something about this disease or by producing a condition which makes it possible for the true

living irritant that causes the formation of cancer to become successfully active.

I am sure that there are enough farmers among you to understand what I mean when I say that when you see clover growing you know that the soil is not acid. You can tell when you see certain weeds growing that the soil is not alkaline.

To my mind no matter how thoroughly the soil for the production of cancer may be ready unless there is a disturbance of the circulation unless there is a condition present which inhibits the natural protection of the tissues against the development of the living cause of cancer cancer cannot be produced.

We have an illustration in smokers' cancer one of the examples which were given here. Why does smoker's cancer practically never occur in the upper lip? Is not the upper side of the pipe stem as warm as the lower side? Is it not true that although the patient may not keep his upper lip in contact as long as the lower lip he keeps his upper lip in contact with the pipe stem much longer than many others who secure a cancer do the lower lip? The fact is that the upper lip does not have its circulation disturbed because you have simply the heat there and you have not the disturbance of the circulation due to continued pressure.

Why is it that in the alimentary canal you have cancer on the proximal side of the sphincter of the pylorus and why do you not have cancer on the proximal side of the sphincter of the ileocecal valve? Why do

you have no cancer on the distal side of the sphincter of the pylorus and why as a matter of fact do you have cancer on the distal side of the sphincter of the ileocaecal valve?

There is another element which Dr Mayo mentioned namely this that on the proximal side of the sphincter of the pylorus and on the distal side of the sphincter of the ileocaecal valve you have an acid condition. As stated before clover cannot grow in acid soil any more than certain weeds can grow in alkaline. We have on the proximal side of the ileocaecal valve and on the distal side of the pylorus an alkaline solution on the other side of each of these valves we have an acid solution.

Why do we frequently have a cancer at the upper end of the rectum while we have a cancer at the hepatic flexure of the colon only occasionally and more often at the splenic flexure? May it not be because from the anatomical arrangement of the large intestine there is stasis and consequent irritation of the walls of this organ at these points due to the accumulation of faecal material and this condition is most marked in the upper end of the rectum less at the splenic flexure and still less at the hepatic flexure which interferes with the circulation.

Those of you who are familiar with the literature concerning cancer in fish will remember that the fish that lived in clean water did not develop cancer. Those that lived in water that was slightly soiled by the excreta of these fish had cancer in small proportion. Those that lived in water that was badly soiled had cancer in large proportion. Where did these fishes have cancer? The cancer was located in the gills. Why do these fish have cancer in the gills? Does it not seem reasonable to suppose that this is because their gills are exposed to an enormous extent to this soiled water? Did they have cancer in the alimentary canal? No because the alimentary canal did not come in contact with this soiled water.

Why do we have 30 per cent of our cancers in the stomach? May it not be because the

stomach comes in contact in large proportion with food that is not clean?

Why do civilized people have cancer of the stomach more frequently than do Indians? Is this not because civilized people are manure eaters? Why do they have an enormous amount of cancer of the stomach in Japan and practically no cancer of the stomach in people who live within a few hundred miles away from Japan who do not fertilize their gardens with night soilage? Is this not because you must have a specific infectious substance aside from the local irritation to cause cancer?

You may say that because you have not as yet found the organism that needs this preparation for its growth that therefore we have no right to say that it exists. Who doubts the fact that smallpox is due to a living thing or that scarlet fever or measles or whooping cough are due to living things and so on indefinitely?

We have not as yet found the living thing that causes cancer but we have found the conditions that make it possible for this living thing to get a foothold in the human tissues and to live successfully under these conditions.

It seems to me that logically we must continue to search for the living cause of cancer especially in view of the fact that a specific organism has been demonstrated which causes cancer in plants. Because we know that irritation has to precede the development of cancer we must not lose sight of the fact that we have not searched far enough for a living cause. We must avoid irritation. We must teach our patients that they must not eat unclean food unless it has been cooked. We must teach our patients that they must not irritate their tissues and that exposure to heat produces a dangerous form of irritation. We must have them understand it, we must make the public in general understand this.

But we should at the same time insist upon having clean food to put into the alimentary canal. I am convinced that when this is done we will have an enormous decrease in the amount of cancer.

THE RESTORATION AND REPAIR OF THE WOUND COMBATING CONTAMINATION AND INFECTION¹

B M J R C LORCE W CRILE M R C U S A

THE restoration and repair of the wound may be divided into four stages each presenting its own problems (a) The stage of depressed local resistance and contamination i.e. the first twelve hours (b) the stage of infection (c) the stage of granulation and healing (d) the superficial healing of wounds and defects sinuses deformities etc

Obviously each of these stages presents a specific set of problems each so different from the rest that no one set of procedures will answer for all

In the stage of depressed local resistance and contamination the indications are (a) restoration of depressed local resistance (b) destruction of the contaminating bacteria

The restoration of depressed local resistance includes (1) excision revision (2) physiologic rest

Excision revision The depressed resistance of a contused wound may be most quickly raised by immediate excision of its partially devitalized tissue This must be done lightly and sharply for if there be rough handling needle's moving of compound fractures if piercing hooked retractors tear the flesh and if intermittent muscular contractions grind tissues between the ends of ragged bone fragments then the net result of excision revision is the substitution of surgically devitalized tissue for the devitalized tissues of battle casualty With the aid of damaging inhalation anaesthesia the rough surgeon does slowly and awkwardly what shrapnel does painlessly and quickly—the shrapnel injury is to be preferred¹

Next in importance to excision revision is the application of the great physiologic principle so clearly set forth in an earlier day by Hilton appreciated by the civil surgeon everywhere reaffirmed in war surgery by Sir Anthony Bowlby General Makins indeed by British surgeons generally and no less by Sir Almroth Wright viz

physiologic rest In the last analysis the resource of the patient are the only means of restoration and repair

2 Physiologic rest Physiologic rest includes more than mere muscular and psychic rest it implies equally cellular rest Living cells are disturbed by air by desiccation by physical contact of dressings by many chemical antiseptics by bacterial toxins These points have been strongly emphasized by Sir Almroth Wright whose teaching has given the impetus which has led to the cellular protection of wounds to insure cellular physiologic rest

To secure physiologic rest in the case of a fracture in even adequate continuous extension must be made—an extension sufficient to prevent the loading of soft tissues by sharp bone and to prevent bony fragments from grinding each other Physiologic rest of the soft parts means mass quiet by means of supports—such as plints slings swins and extension suspensions it means for compound fractures and for injuries of the soft parts no tight bandages no tight stitches no accumulation of wound secretions—blood serum etc For open wounds it means that antiseptics must not be damaging that dressings must be painless it means elevation for comfort and the prevention of swelling For visceral injuries it means absolute rest low diet freedom from excitation associated environment Physiologic rest implies no transport no painful dressings no alarms It means noiseless steps and quiet neighbors

In the destruction of contaminating bacteria the first and most dependable agency is the bactericidal power of tissues This normal defense of tissue against bacteria is present only in living tissues and the ability of living tissue to overcome infection depends on its vitality Normal living tissue has strong bactericidal power As vitality is impaired down to the death point so is the bactericidal power impaired to the zero

point Moreover when infection begins the infecting agent itself has the power of diminishing the vitality in advance of the infection through chemical injury tension and swelling Thus as Kenneth Taylor Cuthbert Wallace Bashford and others have shown many anaerobes cannot live at all in normal tissue but only in damaged tissue The anaerobic invasion is made possible only by injury through chemical action through shell injury through swelling or anemia whereby the resistance of the tissue is lowered Pyogenic infections attack most successfully in the wake of a creeping damaging barrage Therefore in a compound fracture that is settling down one goading by a ragged bone will devitalize a small area and in consequence in area of infection with its advancing barrage will be established Therefore we may say that the whole wound is defensively only as strong as its weakest point If the defense line is broken at one point the entire line may give way

As for antiseptics no chemical antiseptic can command good results with bad surgery good surgery commands good results with out chemical antiseptics but the best results are the sum of good surgery and the good use of good chemical antiseptics In the period of contamination the state of depressed vitality of the wound is overcome by exquisite excision of devitalized tissue by general and local physiologic rest by assisting the reinvigorated wound to overcome the contamination by the use of antiseptics that do not interfere with the defense of the wound by leaving the wound temporarily open If thus plan be carried out the incidence of acute infections will be minimized and the wound may be closed early by loose stitches or by adhesive plaster

This is why excellent surgeons may quite disregard antiseptics—for the same reason that Lawson Tait required no antiseptics—it is because the work of Sinclair and Tait produces rifle wounds while the rest of us produce shell torn wounds If it is a military necessity that a patient be rushed down the lines of communication and if the attention of the surgeon is focused away from the principle of surgery and only toward the

antiseptic—to the degree that good surgery is out of the reach of both the patient and the surgeon to that extent must antiseptics be depended upon When the wounded are being received in wholesale numbers when isolated from surgical ways and means when evacuation is urgent and continuous travel compelled when inexperienced surgeons and internists must take the place of good surgeons when the shelter of a cave must needs become a hospital—then antiseptics are a boon Again if a wound has become infected in the midst of good surgical opportunity antiseptics may be required If antiseptics are required then the choice at present would lie among Carrel Dakin b i p eusol the recently proposed dichloramm T and flavine

If the opportunity exists i e if there is sufficient assistance if the wounds are deep and extensive Carrel Dakin is probably the choice If through the rush of large numbers of cases or through want of help Carrel Dakin cannot be well administered then b i p is indicated B i p is an excellent dressing for travel as the wound requires no care for several days If the wound be deep or superficial if there is a rush a good b i p dressing is better than a defective Carrel Dakin Many wounds do well with eusol and many crises travel well with a Wright pack The ideal antiseptic would be a form of energy such as the ultra violet ray Coolidge tube or electrolysis whereby the entire wound and the surrounding tissue could be sterilized at a single service of short duration Solar energy and electric light energy are excellent antiseptics but are not available for war surgery in the area of the advance Conditions are variable—methods must be variable Relative values may be summed up as follows About 80 per cent of a good result is due to a good surgeon and good surgical opportunity 10 per cent to chemical antiseptics and the remaining 10 per cent to after care

In the stage of infection the treatment consists chiefly in physiologic rest in the broadest sense and in addition if there is sufficient pain redness and swelling to indicate the

actual presence of an invading infection many and free incisions should be made into the area of infection—throughout the area of infection—until redness and the damaging tension disappear. The reason for the good effect of free incisions is that they remove an interference with the normal vital defense. In addition to free incisions heat preferably moist heat physiologic rest of the man as well as of the wound and elevation of the wounded member are indicated. Not only free but dependent drainage is always indicated. If however the Carrel Dakin method is used then pool and do not drain. If the numbers of wounded make the Carrel Dakin treatment impossible and this is the rule during active warfare then use b i p. Good surgery contributes about 80 per cent of the treatment. Of the remaining 20 per cent about 10 per cent may be contributed by antiseptics about 10 per cent by after care.

During the period of acute infection the following should be avoided—pain lipid solvent anesthetics rough handling. Rough handling of infected compound fractures under ether or chloroform anesthesia not only spreads local infection but promotes septicæmia. If one were endeavoring to produce septicæmia experimentally one of the best methods would be to first gas the phagocyte with chloroform or ether and then bonejab through the established line of defense.

The acute infection period is usually past in four days leaving a granulating surface protected by a strong line of defense—the wound is now well dug in. The wound that has cleared contamination before infection and the wound that has gone through the stage of acute infection next enter the stage of granulation and healing.

In the granulation and healing stage we have to deal with (a) contaminated wounds that have become relatively sterile and may be closed (b) infected wounds that have become relatively sterile and may be closed (c) wounds with too much loss of tissue (d) wounds too deep and too extensive for closure.

The closed wounds require no further discussion. The deep wounds such as com-

pound fractures present one fundamental problem viz the prevention of the pocketing of pus.

The pocketing of pus should be met by real dependent drainage by correct suspension extension. The accumulation of pus is prevented by what Sir G. H. Makins has aptly termed curtain drainage. Curtain drainage with simultaneous antiseptics under war conditions is at present best achieved by b i p or the Carrel Dakin method. Dichloramin T holds out much promise.

The ideal method by which to secure superficial healing is by immediately covering the surface by skin graft otherwise hot packs of eusol or normal saline alternating with electric lights or sunlight give the best results. When superficial healing has been accomplished the patient has been brought to the final stage—the stage of sinuses of osteomyelitis of deformities of defects of aneurisms of nerve injuries of scar contractions none of which will be considered here.

SUMMARY

Choice of antiseptic methods in the period of contamination. With adequate wound revision physiologic rest for the wound and for the man and good hospital care what is the method of choice in (1) fresh superficial open wounds (2) fresh deep wounds—such as compound fractures of the thigh (3) in the midst of a deluge of patients during heavy engagements (4) when there is a shortage of surgeons.

An open fairly superficial wound without inaccessible areas does admirably with normal saline Carrel Dakin b i p eusol or electric light—perhaps best of all by the last named. A wound with deep injured areas will do well treated by the Carrel Dakin method or b i p. In a great rush b i p is indicated.

Choice of methods in the period of acute infection. With free incisions the best posture and physiologic rest what further treatment is indicated for (1) accessible areas (2) in accessible areas (3) in stress of work (4) when nursing and professional staff are inadequate.

If conditions permit the best single treat-

ment undoubtedly is hot packs in time of stress b i p in deep wounds dependent drainage in quiet times Carrel Dakin When the wounded come in waves and surgeons and nurses are swamped incision and b i p give the best results to the greatest number per surgeon But 'b i p' must be spread on thinly not applied in masses and the wound should not be sutured but should be lightly packed

Choice of antiseptic methods in the stage of healing In accessible wounds the best treatment consists of sunlight or electric light with eusol or Wright's hypertonic solution and hot packs applied for an hour night and morning In the absence of sunlight or elec

tric light however use a protective dressing In deep inaccessible areas—granting always dependent drainage and physiologic rest use 'b i p' or instead of drainage pooling with Carrel Dakin It must be remembered that owing to the lack of dependent drainage if Carrel Dakin goes wrong it goes badly wrong

Meaning of physiologic rest Physiologic rest implies no irritating dressings comfortable position no compressing bandages no painful handling even and balanced muscular pull no accumulation of wound discharges apparatus that will permit necessary moving about in bed without breaking physiologic rest

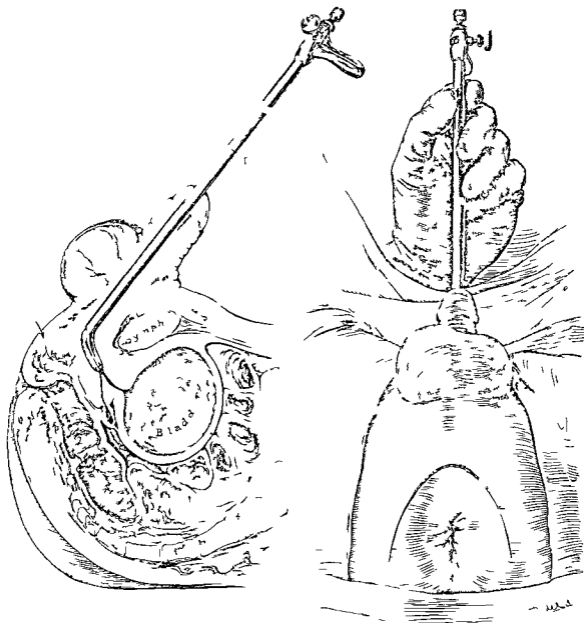
PRESENTATION OF A RADICAL OPERATION FOR TUBERCULOSIS OF THE SEMINAL TRACT

BY HUGH HAMPTON YOUNG M.D. F.A.C.S. BALTIMORE
F m th J m B h B ady U l I I t t t J h H p k i H p t l

IN 1900 the writer (1) presented a new suprapubic retrocystic extraperitoneal method of removing the seminal vesicles and during the next year (2) published an exhaustive study of the literature and added additional cases of his own At that time there had been only five cases in which a radical removal of both seminal vesicles had been carried out and the author was able to add two cases by the new method mentioned in which both seminal vesicles with vasa deferentia the upper portion of the prostate and both testicles were removed *in toto* These two cases were the only ones in which the entire seminal tract on both sides with a portion of the prostate had been removed (Figs 3 and 4)

Material for this survey was principally afforded by various case reports in the foreign medical journals there being but three cases in which tuberculous seminal vesicles had been removed in this country (cases of Weir 3 Bolton 4 and Finney) The operative methods which had been employed were varied and all were remarkably unsatisfac

tory The primary mortality was very high (25 per cent) and the number of cures extremely small so that the writer was forced to draw the conclusion that radical operations upon tuberculous seminal vesicles were not to be considered This conservative standpoint was further strengthened by reports from Kocher's clinic which showed that after excision of tuberculous testicles the remaining process in the seminal vesicles and prostate in most instances completely disappeared or became so much improved as to give very little trouble, and articles by Bardenheuer (5) and by Demitresco (6) showed remarkable results with simple epididymectomy On this account the writer advised in cases of tuberculosis of the seminal tract (*viz* testicles or epididymes vasa deferentia and seminal vesicles or prostate) that the proper procedure was epididymectomy (or castration if the testicle was involved) with drainage of the vas deferens through the upper angle of the incision in the groin and injection of seminal vesicles with iodofornized oil through vas at frequent intervals after operation



T^l h^h Sh^h th^h t^h v^h d^h t^h g^h t^h

Fig^h Sh^h in^h th^h t^h u^h c^h T^h tr^h m^h

For ten years this procedure was followed at our clinic with at times very satisfactory results. In some cases the tuberculous process in the prostate and vesicles did undoubtedly retrogress so as to become almost negligible but in some cases the outcome was not so favorable and as years rolled by and these patients were carefully followed more and more instances arose in which the pa-

tient became progressively worse the urethra and bladder became involved and death ensued from a generalized tuberculosis. Even when this did not occur in some instances life was rendered miserable by pain, dysuria, hæmaturia and other disabling complications.

Our attention was again directed to the question of radical operation and a review

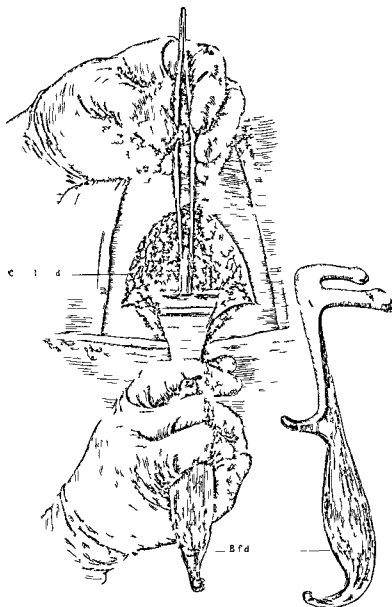


Fig 3 Central tendon put in tension by bit d re tract r previous to division

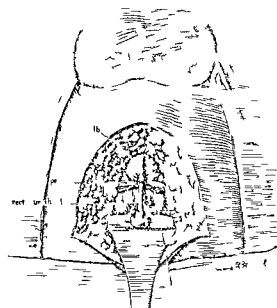
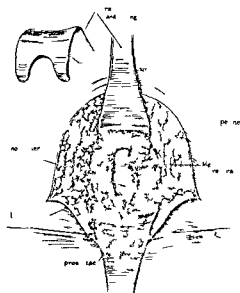


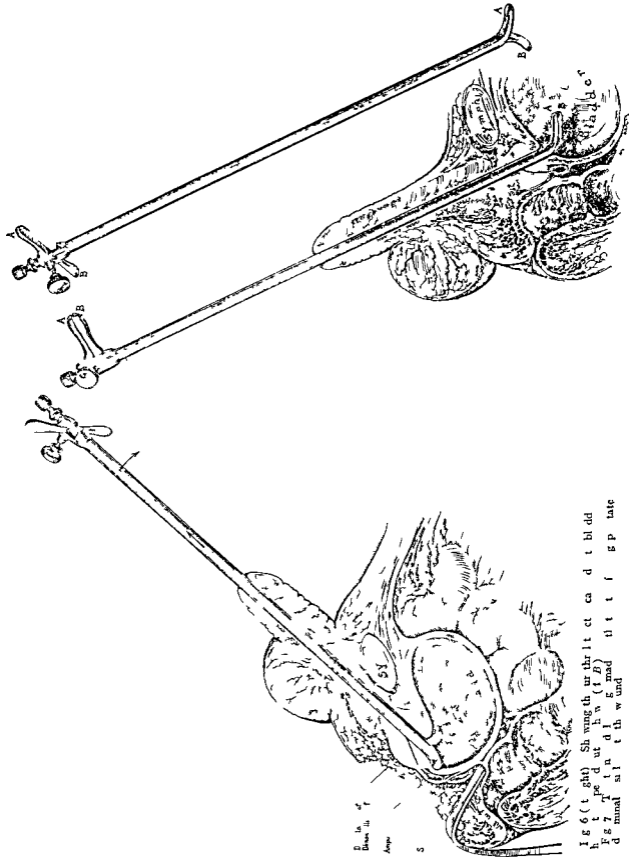
Fig 4 (abo e) Central tendon has been divided exposing recto urethral muscle which is next divided

Fig 5 Special retractor of bulb and triangular ligament has been inserted exposing membranous urethra held up on tractor Levator ani muscles not pushed to each side exposing posterior or superficial layer of Denonvilliers fascia



of the various methods which had been employed was made. The vesicles had been approached through the perineum through the rectum (paralleling the sacrum and rectum) and through the groin. The writer had himself in 1900 proposed a suprapubic retrovesical extraperitoneal operation in which after stripping the peritoneum from the posterior surface of the bladder the seminal vesicles were completely removed along with the vasa deferentia, epididymes or testicles. But in these cases the operative procedure was unsatisfactory on account of poor drainage usually resulting in miliary

tuberculosis. Those cases which had been operated on through the groin and iliac regions suffered from the same complications. The parasacral and pararectal routes were difficult mutilating applicable only to one seminal vesicle and associated with a high mortality. The perineal route alone was left and on examination showed that poor results



I g 6 (t ght) Sh wang th ur l t ct ca d t bl did
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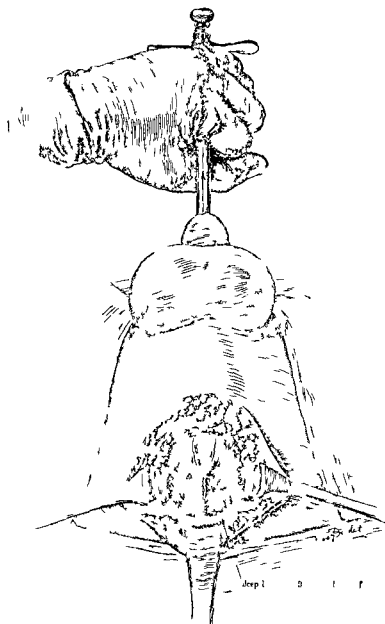


Fig 8 Levators and rectum drawn away exposing fascia of Denonvilliers Y shaped incision through fascia

had been obtained largely through imperfect technique and the inability to reach and thoroughly expose the tuberculous vesicles and vas deferens.

In the meantime (1903) the writer had devised and promulgated his conservative perineal prostatectomy by means of a two bladed prostatic tractor which facilitated the exposure of the prostate and made it possible to draw down even huge intravesical prostatic lobes and to enucleate them easily through the perineum. Cases of prostatic hypertrophy were encountered in which the

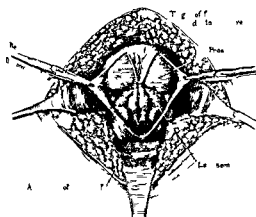


Fig 9 Fascia of Denonvilliers elevated by blunt dissector exposing lateral lobes of prostate seminal vesicles and vasa deferentia

seminal vesicles were diseased and it was found easily possible to draw down thoroughly expose and operate upon the seminal vesicles in addition to removing the prostate. It, therefore occurred to the writer in 1913 to use similar methods for tuberculous seminal vesicles. One of the principal objections to previous operations through the perineum was the usual development of chronic urinary perineal fistulæ. In order to avoid this a tractor of more delicate caliber and longer shaft was constructed which could easily pass (Fig. 1) through the penile urethra into the bladder and thus be used for traction without opening the urethra through the perineum as shown in the illustrations of Mr. Broedel demonstrating the development of this operative procedure.

The ordinary inverted V perineal incision (Fig 2) which I have always employed for perineal prostatectomy has been found entirely satisfactory and after division of the central tendon and recto urethralis muscle (Figs 3 and 4) the membranous urethra and apex of the prostate are easily exposed without cutting the levator ani muscles (Fig 5). Up to this point the tractor has been introduced only sufficiently far so that its beak lies in the membranous urethra thus giving an index as to its location. It is then carried into the bladder opened out traction made and pressure employed (Figs 6 and 7) thus by leverage forcing the prostate and seminal vesicles up into the wound where little difficulty is experienced in uncovering

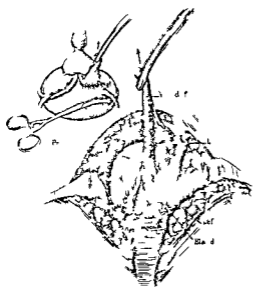


Fig 1 mp

the fascia of Denonvilliers the anterior layer of which forms the covering of and index to the seminal vesicles and vasa deferentia as well as the prostate. In this exposure the levator ani muscle is drawn outward and backward with the rectum exposing the superficial or posterior layer of Denonvilliers fascia

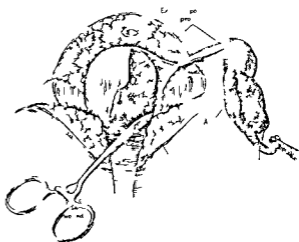


Fig 2

which is divided near the apex of the prostate thus uncovering the shining anterior or deep layer of Denonvilliers fascia. The incision which must now be made through the fascia of Denonvilliers in order to expose the vasa and seminal vesicles may vary somewhat according to the extent and character of the involvement but as a rule a Y shaped incision (Fig 8) has been found most satisfactory for nearly all cases in which both seminal vesicles ampullae and lateral lobes of the prostate are involved. The fascia is then elevated on both sides thus exposing

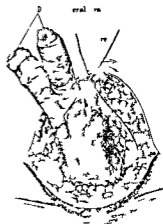


Fig 3

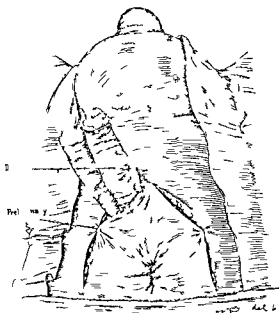


Fig 15 Showing closure and drainage of perineal wound

the lateral lobes of the prostate ampulla and seminal vesicles and leaving the central portion of the prostate immediately beneath the urethra (in which the ejaculatory ducts lie) intact and covered by fascia which aids in protecting them. An excellent exposure is thus obtained (Fig 9) and it is possible to determine exactly how much should be removed whether the disease is unilateral or bilateral and whether one or both lobes of the prostate shall be excised. Another advantage of this method is that the main blood supply which lies externally is thus drawn outward with the fascia and hemorrhage is

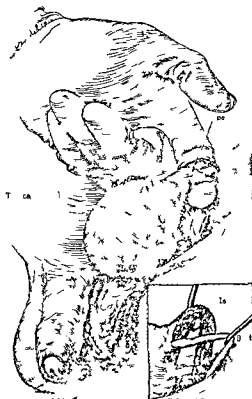


Fig 17 Cord and testicle delivered Separation of vas from vessel

avoided making it possible to see well and to carry out a delicate and accurate blunt dissection without injury of the bladder to which the ampullae and vesicles are often very adherent. The vas deferens should be freed well up toward the point where it winds around the ureter and then deeply clamped and divided the upper clamp being left attached to assist in removal of the upper portion of the vas deferens in case epididym



Fig 16 Incision in groin. Tent in horizontal position on back

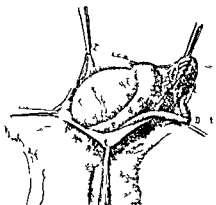


Fig 18 Tunica vaginal opened exposing tuberculous epididymus

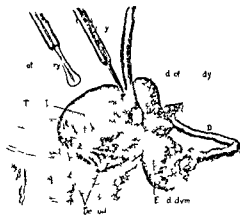
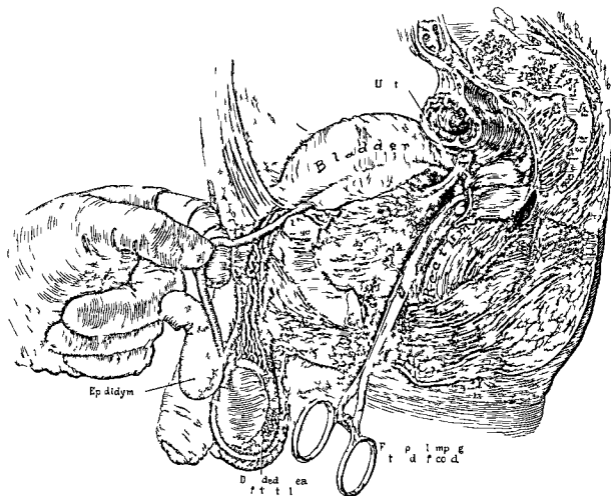


Fig 19 Excision of epididymus completed with electrocautery



mectomy or castration is contemplated. The seminal vesicle on this side is then freed from adhesions being clamped and ligated after division in order to prevent bleeding and working from above downward the seminal vesicle and ampulla are freed until the junction with the upper portion of the prostate is reached (Fig. 10). If it seems desirable to remove a portion of the prostate an incision is made parallel to and at a distance of 5 millimeters from the urethra (and dividing the ejaculatory duct) but leaving sufficient tissue to avoid a urinary fistula (Fig. 11). After this the prostatic tissue is easily removed by enucleation from within its capsule and the fascia ampullæ seminal vesicles and lateral lobe of the prostate are thus re-

moved in one piece as shown in the illustration (Fig. 22). If the disease is bilateral the same procedure is carried out on the opposite side (Fig. 21) and the wound then partly closed the long clamps being left attached to the upper ends of the vasa deferentia for traction later. In this closure two iodoformized gauze drains are provided the levator ani muscles are brought to either (Fig. 14) and the wound closed as in prostatectomy leaving room for drainage (Fig. 15). The patient is then placed on his back and epididymectomy or castration carried out according to the extent of the lesion present. This is also so well shown in illustrations that detailed description seems unnecessary. The incision is usually made



Fig 21 Case 432 Photograph of specimen showing removal of both testicles vasa and lateral lobes of prostate median portion and urethra preserved Castration on one side epididymectomy on other

along the cord just below the external ring (Fig 16) and after division of the dartos the

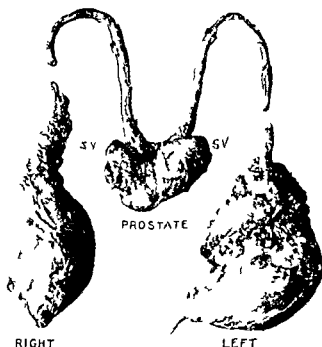


Fig 23 Photograph of first total excision of seminal tract and part of prostate

testicle is delivered (Fig 17) the tunica vaginalis opened (Fig 18) separation of vas and epididymis from veins and testicle carried out and finally division at the upper end of the epididymis made with a cautery (Fig 19) After suturing the tunica vaginalis behind the testicle so as to avoid hydrocele formation and after careful hemostasis testicles and veins are dropped back into the scrotum and the vas deferens which has been exposed up to the external ring is then freed from adhesions in its canal by a



Fig 11 Testicle with surrounding inflammatory tissue vas deferens and a portion of prostate removed



Fig 4 Photograph of specimen from second case removed by retrocystic transperitoneal route



Γ σ ι τ ι ι t t I j t f l t l t h m
K t g g h t t t d m
b l t y i i j t d
F t C i m h g l t l t y
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to and free traction (Fig. 6) produced by an assistant pulling upon the clamp (which we mentioned above as being left upon the lower end of the vas deferens) alternating with traction by the tractor upon the vas deferens in the groin. In this way the vas is quickly freed and the assistant having liberated the vas from the clamp the vas is easily drawn out in its entirety through the incision shown in the illustration (Fig. 7). In this way we have a complete and radical removal of the entire seminal tract with the exception of a few millimeter of the terminal portion of the ejaculatory duct and we have also a conservative prostatectomy leaving the urethra and bladder intact. The procedure which is far more thorough and radical than any other which has been proposed is carried out with great ease and is entirely under visual control. It is not our intention here to make more than a preliminary report and case histories will not be given but we can say that the results obtained have been extremely satisfactory and apparently radically curative in the majority of cases some of which have been very extensive.

It has long been shown that very satisfactory results were obtained by nephrectomy in tuberculosis of the upper urinary tract but occasionally the tuberculous ureter

which cannot be excised in its entirety gives trouble and tuberculosis of the bladder sometime persists. With this radical operation for tuberculosis of the seminal tract the removal is more complete and the results even more satisfactory than with nephrectomy.

The illustrations (Figs. 5 and 6) show first of all the impossibility of satisfactory drainage through the natural passages in cases of tuberculosis of the seminal vesicles and the ampulla and epididymis. The tortuous sacculated character of these structure is graphically shown in dissections, coronion specimens and X-ray photograph after the injection of thorium nitrate. It is therefore easy to see how both chronic inflammatory and tuberculous involvements are persistent and the importance of operation upon the vesicle in both of these conditions is clear. The necessity of visual inspection in order to carry out a thorough operation is also self evident. The drawing depicts the use of the long urethral tractor the exposure obtained with it and the various procedure which can be carried out upon the ampulla, seminal vesicle and prostate.

In a forthcoming paper I hope to present an array of case reports which will demonstrate conclusively the curative value of radical operations upon this deep seated form of tuberculosis which has hitherto been considered beyond the satisfactory reach of surgery.

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CHOLANGIOGASTROSTOMY

WITH REPORT OF A CASE

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Internist Hospital

SURGERY of the common and hepatic duct demands a perfect knowledge of the normal and anomalous anatomy of the region. It requires as well a knowledge of the pathologic modifications which result from different pathologic processes particularly gall stone complications. An operation to reestablish the common or hepatic duct is not very often done for it is considered fundamentally laborious and slow and an operation which is liable to produce shock. Dr. W. J. Mayo¹ said:

Operations for the restoration of the common bile duct are usually of a formidable nature not only because of the difficult technique but because of the poor condition in which these patients come to the surgeon. As a result of the former operation and combination of the local irritation there are always extensive adhesions and in these adhesions are an unusual number of thin walled veins which tear readily and flood the field with blood or keep up a continuous oozing thus adding to the difficulties of the operative procedure.

The majority of cases reported in which some surgical procedure has been carried out on the hepatic duct are those which have been operated upon for tumor or chronic obstructions due to strictures or impacted stones. We find in cases of chronic compression of the duct be it extrinsic or intrinsic a dilatation above the obstacle and because of this dilatation restoration by anastomosis with the stomach or duodenum becomes quite easy. On the contrary when there has been a trauma producing a biliary fistula instead of a dilatation of the duct being present there is an area of intense irritation surrounding the ducts and thus makes the operation much more difficult.

Anastomosis of the duct with the duodenum is done by Kehr, Mayo² and others.^{3, 4, 5}

direct end to end suture making a plastic (C. H. Mayo) or using a T tube (W. J. Mayo) end to end suture with resection of the narrowed portions implantation to the duodenum of a rubber tube as suggested by A. G. Sullivan⁶ but leaving a channel not covered by mucosa. Then direct relation of both mucosae but using also a small tube. Our case was of this type but only an anastomosis between one of the right hepatic ducts with the stomach. But as we had a big canal and some very small ones we put the rubber tube inside the big duct (4 centimeters) and made afterward the mucosa and all the corresponding portion of the wall of the stomach apply itself over this denuded area.

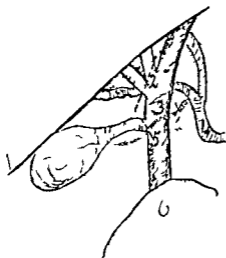
Very recently Drs. Ginsburg and Speece of Philadelphia⁷ in plastic surgery of the hepatic duct have used a section of the posterior rectus sheath fasciæ including the peritoneum thus encircling the small rubber tube and becoming afterward the canal.

The history of the patient is as follows:

J. D. age 41, Argentine. She had a positive lues and pleurisy ten years ago gall stone symptoms five years ago. In her first attack she became icteric and had colorless stools. Afterward she had severe attacks. When she entered the hospital she had a very painful zone in the right subcostal region. Diagnosis: cholecystitis. Through a 1 cm. incision we reached a very small gall bladder with retracted and altered walls and with the omentum and duodenum adherent. Between the gall bladder and the liver we opened a small abscess containing about 5 cubic centimeters of pus. From the bed of the gall bladder to the hilus we began separating the adhesions from the omentum leaving in place those of the duodenum. Then we followed the technique advised by Moynihan searching for the pedicle and making a small rhomb dissecting the peritoneum and subcutaneous tissue (See illustration). It was in making this dis-

Cholecystitis
K. H. Mayo
M. W. J. Mayo
T. J. Mayo
C. G. Mayo

See illustration
A. G. Sullivan
C. H. Mayo
A. G. Sullivan



l l f t l l p t l t h
p d d t 4 l p t t l t l h m b
d o d m

that I l g l th h p u t l u t I a f t l
l g t l p a a t e l y t l l h u a t l y t l u t a n l
the v t r r y O n g n t h c o n l u t
I l v e l a l l h l n t I t t a c h l n
m p t a t t h u t f i r t b u t t n y r r e I
f o u n d t t r m a l l e j t t h e f e
f l l y Th m e l t b l e t i o n o f
r g h t h p t d e t h h h a l a n i m m e d t b
f u r t a f t r t t a r t i g f m t h h p u t l t
(S h u r) K h h m l e m l r l e v a t i o n s
i n 4 p r n t f h i e I t h u k t t n u t
o f i n f a t n i t h e p p t n a l e t
n o t s a f r e d u t m a k k n f l c t n
t h l t c e a P b l l y a l l s
l t t t n t h e a t l t a n t l t d t l
l r l y c o n t u u t r i c t n t h t n m a l
c o m p l t A f i t c o u l d l y a v v a l l
o p e g n t h g h t b o r l r t l h j t l e t
W e t n d b y t h e p t p n g t h t l l u t
a s p e m e b l a n d a o u n d n t t h d l n u m
w l u t f i c u l t y W d a t l n l s t d
b t l u r a h e p a t d u c t s a r d N l a t n b b
t u b e

Th t r e t u b s r i n t r o l e d n a l a g e
(M a y) T l t h r e e f l l v i n g l a y b l d i s c l a g l
t h r o u g h a l l f t h e t b b u t i n g e t r q u n t i
f r o m t h n e t l e c m m n l u c t O t h f r t h
d y I t o k u t t h e t u p r h j a t t u b a n l
n t h t e n t h d a y t h m m n d u c t t u b U n t i l
t h e t e l f t h d a y t l p a t i e n t h a d c l a y l l t o o l
t l a d o e f l o m l t h c h a n g l b u t t h
p r l y S e e l d a y s a f t r a d t e d l a r g e
c m n u d a n d t h e s t o l s e r a l m t o m p l t l y
c l a y l o r l T l g n e a l s t e o f t h p t i n t
a r y g o d

J o W e l v e m d e e v e a l a t m p t s f o l l o
g t h t h n q u o f K h r t o p l g t h h s t u l t u t
u c c e d d o n l y l m i n h g t l q u n t i v

o f l u l l c h a r g e l T e t h e l s c h a r g e s t o p p e l
c m p l t l y b u t t h l i e n t l c a m e c h i l l y a n d
f i h a n t l e g e l n i t n a s l a d T h e e
e b u t t m j o r a r y c l a y c l c l t o l

J n S e l g e r t R e c t o f t h e
r t u O m e n t m a l h r e n t t o p r e t a l p e r t o n
n m l e l l l t h e f u l a r e n d t h e n c u t t h e m
t l t t h l d c m i n g u t o l l i n d c t e t h e
n u t f t h c l T h t m a c l d o d n u m
l h m a l a l l c k f a l h c i n s h i c h v r e
l i f t l t l t I p r t l t h e c o n d p o r t i o n
f t l l u o l n u r (k o c h e p e d e) t s c u r e
b t t m b l t n n d t o e x a m i n a t t h e s a m e
t m t h r t l l a t p t f t h c o m m o n d c t
T h e l l u a n n t s f i r s t p o r t i o n a s o a d h r e n t
t h l h r t h a t I l a t l e t a s m a l l p o r t i o n o f
p a h y m t v i l l o n g l a m a g e t o t h d u o d e
u m W t h e n l s e c t e d o r t h z n e o f t h e p e d
l l h l v s l i n g m d e c a v w h e n e f o d
p r m a b l t h f r a m n o f W i n s l W h a d t o
p u t u r t h e p o r t a l e i n t o i d e n t i f y t a n d s e
m a l a f t e w a r d c r u l d i s e t n o f t h c o m m o n
l u c t W c u l d s e e r y v e l l t h e h p a t i c a r t e y
a n d t l f r t n l T h e f e n t h e c o m m o n
l u c t a f n d l l t h e l l r a t h e t h c k e n e d
b t e m d t o b i n g o l s h a p g g o n t o t h e
l l l y T h p a r a t o n f a d h e s n h a d l f t a
p r t n f t h e l e v i t h u t c y s l e a n d f l u i d
b l e n t i n u a l l y z n g I t i n t h p o t n
t h a t e s n l n f o u r s p r a h p a t d u c t T h i s
p r m a t l t a N o 2 N e l t a r b b r t b e i a
c e l g t n i n S r o u n d t h i s o n l e t h r e
v s a l t f b o u t 3 i n h s o f o n t u o u s b e
i g M s t f t h c h a g c a m e f r o m t h o t h r
p l l i t l u c t

T h l l t c l q u a s u s i n r e s t o r g
t h e t l l t A s m a l l t u b a s t r o l u c d 3 c n t i
m t r s i n t o t h e p r a t e p a t l u c t (r e p r e s e n t e d s
a l l t e c) a n d t l n u l b y h h r m e
t e t l h p a t i u t h T h t b s c u t a t a
d i t t e f i n c h e A p s t g s u t u r e
p l e l a t h m i d d l e t n o f t h t m a c h a d
t l u h s a l l p u n g t l t b i r t r d e l
l g t h o u t l e a n g t n o n o r t h e t u b T o
a f t t n t h t m a c h a s f i f t o t h u p p e r
p o t i n f t l g a s t l e p a t i c o m e n t u m t o t l e s u s
p e r o v l g m n t a n d a t o l t p e r f o r a t i n g
t h a p l e f l c h o W e e d t h o m e n t u m
t h p o t i o n f t h l i v e t h a t d e u d d O d o e
u m v s e p l a l T l e p y l u s a l l t u t e d
T h o u d s c l o d t h d r a T l e r e
l i t n f t h m d l l p a t f t l e s t m c h i t h t h
u p p r p o r t u f t l h p t e d u t m k t h u i o n
n u c l m e p c t c a b l t h n u u t h t h d o
d n u m

T l e a a d s c l a g e f b i l e f o a d a y s T h e
p t i n t t o k n u r h m e n t b y m u t h t h e t h i r d
l a y O n t h e t l l a y v e f u l t h u d i
g o d s h a p e d i t h s m l l a m o u t o f b l e d s c h a r g
g l o m t h d a y t h e r e c e o l r e l t l s
o m t n l t e y v e f a h u t h t y p b u t n e e r
n t n a l l y O n J l y 7 t h e p t i n t s l

missed from the hospital. The tube has not been found. The X rays were negative. We have made several gastric tests but have never found either salts or biliary pigments.

The patient has been seen every month and now ten months after operation her general condition is good but she is somewhat constipated. Well colored stools are passed. For the first two months after operation the patient complained of slight attacks of diarrhoea.

The damage was done just at the entrance of the supraduodenal duct which was abnormally bifurcated. What was the condition after ward? We had to deal with a small orifice laterally situated on the hepatic duct and two other ones over the hepatic tissue. More than half of the entire bile was discharged through these two openings. Should they have been shut off by ligature should they have been drained or should they have been sutured using a Y tube? We thought it would be better to drain the bile as the patient was not in good condition and this would shorten the operation. Also we hoped that by tapering the openings to produce a different course the bile would enter Vater's papilla by only the left hepatic duct. We decided to use a triple drainage—a large tube in the common duct and two small ones in both supraduodenal ducts.

The result was as feared and a double biliary fistula formed. The patient lost about 100 cubic centimeters of bile daily though the opening in the common duct closed as usual. Periodically the stools were a whitish color.

As I have already said we tried several times without result to prevent the bile from discharging. We placed pieces of gauze and cotton wrapped in rubber tissue in the canals but it was useless. However it was very interesting to note that each time symptoms identical with those of bile infection developed. We had then to subject the patient to a new operation with the idea of restoring the supraduodenal duct. A direct anastomosis was impracticable on account of separation between the damaged canals and the hepatic owing to the symptoms of infection that supervene so many times we deemed it advisable not to try ligating the ducts.

We considered combining the Sullivan and Kehr procedures using the Sullivan tube and at the same time making a direct mucosa union as in a cholangiostomy.

Only one of the two orifices which were situated about one centimeter apart in the first operation was found in the second operation to have an explorative lumen. It did not appear as a real duct. We saw just a large orifice which admitted a sound for a great distance. The other orifice as I have already stated had a small lumen and the canal could not be explored. Anastomosis with the duodenum was not easy although we had separated its second portion (Kocher).

Is there any inconvenience in the emptying of bile directly into the stomach? Kehr who has performed more than 60 cystogastrotomies and 3 choledochogastrotomies speaks in favor of it. Employing the tube makes the technique much easier. The tube ought to be eliminated in a few days when the catgut is absorbed thus leaving the canal formed. In that way the mucosa of the duct combines with the gastric mucosa. In our case the tube was not eliminated. X ray examinations did not disclose the tube. We cannot tell whether the tube fulfilled its mission of hepatogastric communication or if on the contrary an inflammatory process has taken place and the supraduodenal duct is completely obliterated compelling the bile to be diverted by the left hepatic duct. We have made several test examinations at different hours in relation to meals but we have never found bile. This fact is very suggestive that the right supraduodenal canal is obscured. We must remember that at first we had two canals with quite large lumina and that after 45 days one of them was nearly occluded.

If we take into consideration the general good health of the patient ten months after operation the stools normal and the patient not icteric we must therefore accept the above conclusion or must assume that the bile is at present running a backward course and reaches the duodenum by the left hepatic duct or we must assume that on the contrary notwithstanding the inability to demonstrate bile by stomach tests there is a direct relation between the biliary system and

the stomach. The third consideration would be that a portion or all of the right lobe has become atrophic.

Nas e cited by Thoele has done some experimental work along this line. He has ligated several times the left hepatic duct in

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000 1001 1002 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021 1022 1023 1024 1025 1026 1027 1028 1029 1030 1031 1032 1033 1034 1035 1036 1037 1038 1039 1040 1

do, and discovered that there was a shrinkage of the left lobe due to a diminished circulation in the portal vein branches. He observed a hypoplasia of the hepatic parenchyma with a hyperplasia of the connective tissue and some small foci of necrosis. The right lobe presented a vicarious hyperplasia

ELLPHANIASIS TREATED BY KONDOLEON OPERATION¹

DAVID E. SISTRUNK, M.D. RICHARD M. SISTRUNK, M.D.

I m b M v C l

SEVERAL years ago Kondoleon of Greece described an operation which will probably occupy an important position in the future surgical treatment of lymphatic obstruction. His report of the results obtained by the method and the case reports which have been published by several surgeons in this country who have used it (Mitas Royster Hill and others) have been sufficiently encouraging to make it appear that relief may now be offered to many patients of a class which formerly has failed to respond to the other methods of treatment.

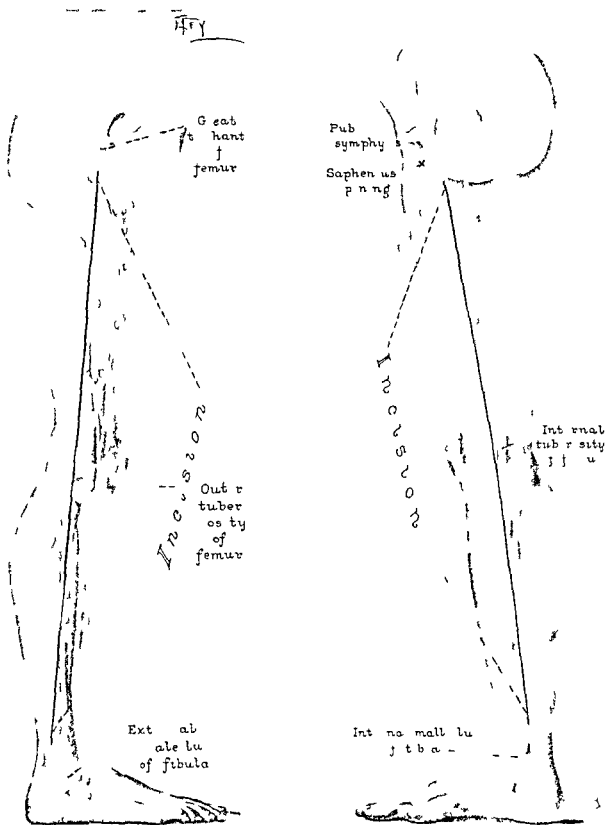
Until this method was suggested we did not possess any means of satisfactorily dealing with many patients suffering with elephantiasis and lymphoedema and in certain instances we had been compelled to resort to amputation in order to relieve such patients of the pain and discomfort accompanying these conditions. The operation which Kondoleon has suggested is a safe and simple one and it is to be hoped that it will stand the test of further usage and prove itself to be a means whereby we may successfully deal with these stubborn conditions.

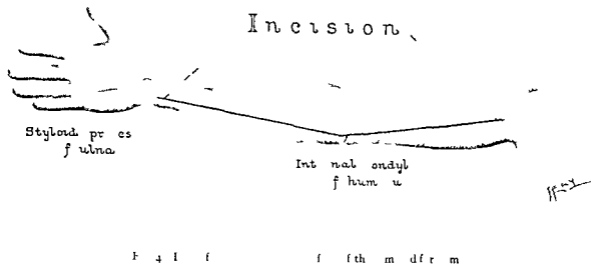
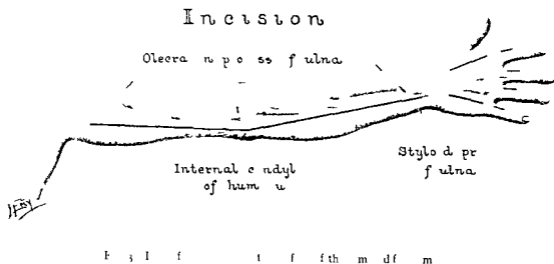
Prior to 1908 operation in which the large arteries were ligated and other in which large amounts of adenomatous fat and hypertrophied lymph were removed had been used but with poor success. In 1908 Hundley suggested a method of operating for lymphoedema of the arm secondary to cancer of the breast which he termed lymphangioplasty. His operation consisted in the placing sub-

cutaneously from the wrist to the normal skin around the axilla and shoulder of long strands of alk. This was done with an idea of having the e strands act as setons and drain the fluid from the swollen arm into normal tissue. His preliminary report was encouraging but later the operation was proved to be unsatisfactory and now is seldom used.

Lanz in 1911 reported the result obtained by a new type of operation which he had performed on a patient suffering with idiopathic elephantiasis. His operation consisted in making a long incision in the thigh exposing the femur and trephining this bone at several points. Strips of fascia were then carried down through the muscles and inserted into the openings previously made in the femur and the wound closed without drainage.

In 1912 Kondoleon in a series of papers in which he gave credit to both Handley and Lanz for the work they had done in the connection reported seven cases of lymphatic obstruction in which the patients had been operated on by the method now bearing his name. The operation was based on sound reasoning. He realized that the superficial and deep lymphatics were distinctly separated by the aponeurosis covering the muscle. His study had shown that the axidema in such patients was usually limited to the subcutaneous tissues and fat lying between the skin and aponeurosis. By removing portions of the aponeurosis he hoped to connect the superficial lymphatic with those of the deep





group and in this way obtain drainage of the superficial structures

In the group of cases which he reported various types of lymphatic obstruction are to be found. Four of his patients had developed trouble following infections, one after the removal of the inguinal lymph glands, another was a patient with idiopathic elephantiasis and the last one a patient with an edema of the arm secondary to a carcinoma of the breast which had been removed and had later recurred in the axilla. The results he obtained were uniformly good.

The technique of his operation is as follows: Long incisions are made along the inner and outer aspects of the affected limb and through each of these a large piece of edematous fat is removed. The aponeurosis is then opened and a portion of it three or four inches in width is excised. The wound are closed without drainage in such a way that the skin with the fat attached to it comes in contact with the exposed muscles (Figs 1-5).

I shall report in this paper three cases in which the operation was done according to Kondoleon's method. Each of the operations

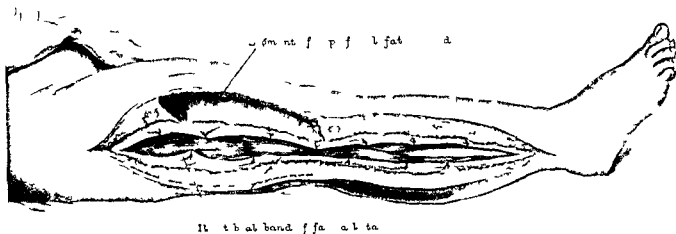


Fig. 5. Technique of Kondoleon operation. Aponeurosis has been incised, separated from the muscle and sutured in such a way as to allow the subcutaneous fat to drop on the muscles after the wound has been closed. A portion of subcutaneous fat has been removed.

was done in a different type of obstruction. In two enough time has not elapsed to know what the end result will be but marked improvement has followed the operation in both cases.

CASE 4116. A female, aged 21 years with the congenital type of elephantiasis of the left leg which had been present since she was one and a half years of age. When first seen in the Mayo Clinic the patient was fifteen years old. At that time there was a tremendous enlargement of the left foot, leg and thigh and a marked thickening of the skin covering

these. In August 1911 according to Handley's method one silk strand was placed on the outer and one on the inner aspect of the leg from the ankle to the region of the left groin. The patient returned six months later without improvement; in fact the enlargement had increased. In February 1912 a double silk strand was placed subcutaneously on the outer and inner aspects of the leg and the inner of these strands was extended upward into the fat of the abdominal wall while the outer strands were carried as high as the left axillary line. The condition remained unchanged until her return more than four years later. At this time (December 1916) an operation of the Kondoleon type was done first on

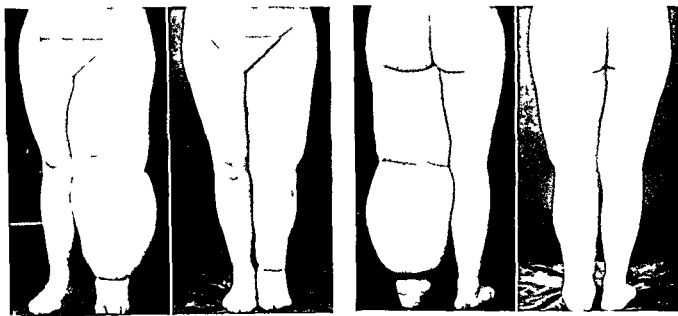


Fig. 6. (4167). Before and after operation and three months after operation.

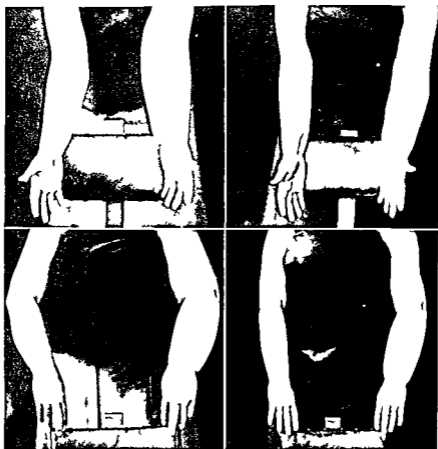


FIG. 6. (A) Front view of the patient's lower body and legs. (B) Side view of the patient's lower body and legs. (C) Back view of the patient's lower body and legs. (D) Another side view of the patient's lower body and legs.

the out r sid of the leg i bo t m nth l t r
n th i n r d Th m p o m n t k d
from th b g g and t th i m f l d h g
M rch o th l g l m l th n l f r
th o p r t i o n L t t d th p t i n t
r t r n d h o m d t t t t t h l e g h i t n o u d t
d m h (Fig 6)

CASE 06 Af al g d v s t l l
ph i t a s s o s t r Th h t g t u t l
sh a s t t v r f g h th g t u t l
inf t f l l g a t o n th l t arm
Aft th n t n o u l h a l c h m
g d n d t u n t l o v r l f r g t h
C l n A t t l s t m s l l n g i t h l f t l n d l d
d e l p d n l l l o l y p r g j u t l t h f
r m a d r n a l l t h p Sh l d
n i t t a k f v t h m n t h l l p t
Th h s t r y d h n l n g n t l l b
I r t e l l t t l b Dr J p l A L l o t t A t t l
t m i o u r m t i n t l p t t p n t d
d i f s l l n g i t h f d h d
Th s l l n g v m k d n t l h n d d

g d u a l l y d m s h d u p t a p o i t a f e i c h e s
b e l o t h a r o m i l c It a l s o l e d t h e
p r o x i m l p h l n g f t h e n g r s T h e r e a s a
d f i n t t l k n g o f t h k n J u l y 3 1 9 1 a n
p t o o f t h K n i l l o n t y p v a p e r f o r m e d
t h o u g h i c i o f i e o r i n l e s l o o n t h e a n
t r o r n i p t r s u f a f t l e a r m a n d f o a r m
N o n e i n r e a d e o t h e h a d C d r a b l e
n p i n t f i l l e d i n t h a r i a n d f r a m b t
t h d t o n t h h a n d e m a n d t i o n a r y
S o m l l g l r e m i d b o u t t h l b o A
e c o d o p e r a t i o n s d n e S p t e n b r o 1 9 1 a t
h l t i n t o n i o n m a l o n t h e d o r a l
u r f a c e o f t h l d n d o r n c i l o f t h l a t a l
r f a c e s f t h l b o M u l t p l n o r e a l o
d e n c h p n l p h l a n o f t h t g r s
A l t h u g h l u t s h t t u m t h a l p d n e t h e l a s t
p r t n t h e i m p n n t h s b n q u e n o t i c
b l e (F i g 5)

CASE 06 S A f m a l a g d v r v t h
l y m p h a l m a t t h l e f t a m f o l l o g m p t a t o n
o f t h e b r e a t t h r m o l o f t h a l l y g l a n d s
T h o u l l a d n o t b i n t i d T o m o n t h s
a f t e r t h p t o n t h a m l e g n t o s l l g o v n g



FIG. 8 (7099) Three months after Kondoleon operation. No operation was done on the dorsal side of the hand and the swelling has remained unchanged while the arm has returned almost to normal. Unfortunately no photograph was taken of this case before the operation.

slowly but progressively worse and involving the dorsal surface of the hand, the forearm and the arm nearly as high as the shoulder joint. There was no thickening of the skin. September 1, 1911, a Kondoleon type of operation was done. Long incisions were made on the outer and inner aspects of the arm and forearm from a point a few inches below the shoulder joint down to the wrist. All of two incisions were made on the posterior surface of the hand. The swelling in the hand and arm

decreased at once and at present (two and a half months after the operation) they are almost normal in size. There has been also marked improvement in the forearm but some swelling is still present. Should this persist it is possible that benefit might be derived through the excision of more of the aponeurosis (Fig. 9).

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contained much necrotic tissue and that three or four circular ulcers such as have been described above were present in the skin in the immediate vicinity of the incision. There was also observed the characteristic glairy mucoid secretion. From this time on the condition of the wound became worse. The edges were covered with a thick layer of necrotic tissue and the closure of the wound was greatly retarded. The circular ulcers adjacent to the wound increased greatly in number and the intervening skin was erythematous. There were no subjective symptoms other than burning and smarting. The temperature remained normal and the general condition of the patient was excellent. Eight days after the prostatectomy he was up walking around with his clothes on and remained able to do this until his discharge from the hospital. The highest leucocyte count was 15,000. On two different occasions the organism to be described below was obtained from the necrotic tissue at the base of the ulcers and from the mucoid secretion.

Various means were used in an attempt to promote healing and check the progress of the inflammation such as hot dressings, frequent cleansing and irrigation with and without various antiseptics such as alcohol, bichloride and boric acid and frequent application of iodine to the ulcers. None of these measures appeared to have any effect whatever. Finally on June 27, after nearly a month of no apparent progress in healing, each of the ulcerated areas was cauterized with stick silver nitrate as were also the edge of the incision. On the following day there was no longer any discharge of mucoid material and no new ulcers. Within five days the wound was entirely closed and the patient was urinating in the natural manner. He was discharged July 1.

The organism which was found and identified as the bacillus mucosus capsulatus by Miss Helen Ick, presented the following characteristics. On agar it was short with rounded ends, length about three times as great as width, approximately 3 microns. It was seen singly and in groups but with no chain formation. It stained readily with aniline, gentian violet and methylene blue but did not stain with Gram's method. It was non-motile and no spores were observed. It grew abundantly at 37.5 C. was aerobic and produced no pigment. It fermented dextrose and lactose but not saccharose. After 4 hours 5 per cent of the dextrose had been fermented and 10 per cent of the lactose. There was no additional change after 48 hours. The reaction in the fermentation tubes was alkaline. Milk was made alkaline and was coagulated in 48 hours.



FIG. 1. Photograph of lesion. A, Glairy mucoid secretion in incision; B, typical ulcers.

After about 3 days the milk became neutral. There was a markedly fetid odor in all media similar to the odor noticed about the patient. There was no indol production. On blood agar there was a profuse slimy, grayish growth which was irregular, moist and slightly raised. At first the growth was only along the line of inoculation but later it was spread over the entire plate. There was no hemolysis but marked discoloration of the media after 48 hours. Intradermal and subcutaneous injections of the organism into guinea pigs produced no lesions.

A piece of tissue excised through one of the ulcers showed under the microscope only simple inflammatory tissue, chronic in type. There were relatively few polymorphonuclear leucocytes but a large number of plasma cells and a considerable number of eosinophiles. The leucocytic infiltration was present chiefly immediately beneath the Malpighian layer. An occasional bacillus was found in sections adjacent to necrotic tissue.

SUMMARY

A peculiar ulcerative lesion of the skin following a suprapubic prostatectomy in a man 83 years of age was found to yield an organism resembling the bacillus mucosus capsulatus. After running a clinical course of over three weeks with no improvement it responded quickly to a single cauterization with stick silver nitrate.

IMMEDIATE SURGERY OF UNSHOT WOUNDS OF THE CRANIUM

REVIEWING FORTY SIX RECENT CRANIOTOMIES PERFORMED WITHIN A FEW HOURS AFTER THE RECEPTION OF WOUNDS

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INVESTIGATION of scalp gunshot wounds is practically a routine procedure in war surgery when time and facilities are given. In a trial series of 25 harmless appearing gunshot scalp wounds the author found three fractures upon investigation. In casualty clearing stations even the most experienced surgeons admit an inability to make positive statement in all instances of head wound and the roentgenograms required are either too numerous to be taken or their finding are often too unsatisfactory. Close inspection by the surgeon after scalp excision is necessary. If excised such simple scalp wounds heal rapidly and cleanly and are a satisfaction to patient and operator. Local or general anesthesia may be employed.

For the immediate surgery of head gunshot the author refers of course most particularly to war wounds and the services rendered by the trained and ever ready surgical team of a casualty clearing station and the preliminary examination of the patient must be considered a part of the general technique. Men arriving in coma from head injury or with hernia cerebri or gross cranial lesion are prepared at once for operation if their general condition warrants. If it does not they are warmed, stimulated and cared for in a resuscitation ward until in condition fit for surgical procedure. Operable patients are sent to pre-operation ward for head shaving, later for roentgen examination if penetration is found without exit regardless of symptoms. A rush of work may forbid this most helpful necessary examination so that only deeply penetrating wounds with severe symptoms can be subjected to localization. The operator's experience and skill are depended upon to aid him in subject not shaved.

A general description of technique may suffice for the usual operative steps and a

repetition in more detailed pathology. Scalp excision is made one quarter to one half an inch wide of contused edges disregarding the amount of tissue which must be sacrificed. Unhappily war wounds have no respect for cranial topography consequently a scalp tourniquet cannot always be used. Large scalp hemostats with small clamping area and long handles which really are an aid in retraction minimize the bleeding. This hemorrhage is often free but seldom causes worry. Soiled and tousel pericranium is removed with the scalp or is scraped away with a periosteotome if necessary to avoid infectious thrombosis of emissary veins, a fertile source of meningitis and optic sinus thrombosis.

Bone puncture or depression of the inner table except the smallest scratches require investigation. Trephining or chipping away of both table with small rongeurs is required to determine the state of the inner table and extradural space. It is best not to use the chisel and mallet on the skull although there is no valid objection to sharp small gouges and wooden mallets. When the dura has not been punctured it is questionable whether it should be opened in a field of unknown sepsis. Subdural clots which remain sterile frequently absorb with no ill effect. Should intracranial increased tension necessitate decompression it is best done in a clean area remote from the gunshot wound. Shrapnel and bullet traumatic effects on cranial bone and brain tissue may be different on account of the twirling induced by rifled bores. Bone lesions caused by bullets may be correspondingly greater to the inner table or brain track and require more thorough investigation. This rule applies particularly to gutter wounds.

A constant irrigation stream of hot normal salt solution keeps the operative field clean

washes out clots small bone and other foreign body fragments and partially controls hemorrhage. Such mechanical cleansing of exposed cortex should be encouraged. If the dura is contused or lacerated it is excised sparingly the bone excision being made large enough to give a margin of this healthy tissue within its edges. Bone excision is minimized but *must* include provision for removal of the severely comminuted and dirtied area and for sufficient dural excision. After these steps there is quite constantly seen a rushing forth of lacerated softened cortical material and clot from the cranial opening. All is swept away by the flushing of normal salt. If the foreign body is relatively superficial it is felt by a small blunt scoop or curette or by the finger inserted daintily into the brain track. Bone fragments may be mistaken for the metallic foreign bodies. The author has found wood splinters and in one instance a stone the size of a robin's egg embedded in the brain. (See description of Patient No. 13 which follows.)

The operator may irrigate with the stream of solution directly into large and deep tracks of the brain bone fragments and disorganized brain will frequently float out bringing with them infectious material. Usually the metal carries in infectious hair scalp or cloth. Consequently from the standpoint of later infection and cerebral irritation the patient is offered a better prognosis if the metallic foreign body is removed. There is some dispute about the relative irritative power of metal and of bone fragments which are showered down along the track made by the missile. These bone fragments are reasonably sterile we expect the most of the cloth and external infectious surfaces carried in to progress with the metal a clinical finding proved beyond doubt in gunshots of other parts of the body. Roentgenographic plates in brain penetration will seldom fail to discover the bone shower some fragments being frequently scattered out at an angle from the main wound track. From an operative standpoint in some instances it may be considered a technical *fau pas* to attempt their removal but they may cause irritation by their presence. The author believes that

those washed out or easily drawn out are better removed but brain damage attempted in eliminating very deep or widely scattered bone fragments may not be compensated for by the material obtained. It is to be anticipated that this bone will be absorbed if recovery follows as is non functioning bone in any tissues of the body.

Foreign bodies in accessible regions which are localized or palpable can be coaxed out with a dull spoon. When metallic and very deep they may be drawn out by the electro magnet the sterilized obturator being first passed to the foreign body and the magnet attached by a ball and socket connection before the current is turned on. Jumps and jars of the quickly attracted metallic body within the brain are thus obviated. When the metal has traversed the skull beyond reach is down into the basal fossae or the track passes perilously near large intracranial vessels or the sinuses the most delicate manipulations are necessary to avoid hemorrhage although the operator may be loath to give up the search it is better to take no risks and depend on track cleansing without foreign body removal.

In one patient (Case 18) the author was enabled to palpate both the torcular and straight sinus to make sure of their non injury and to remove a sizable piece of metal from a position just in front of their junction.

Complete closure of the scalp with or without capillary drainage at one angle of the wound is the last operative step — and one of the most essential following craniotomy. The excised wounded dura can very rarely be approximated. The scalp can be dissected widely from the pericranium so that it stretches and permits closure of large defects. On the whole the pericranium should not be removed from the healthy bone surrounding the wound. If the scalp fails to meet over the denuded bone without undue tension it may be slipped over by parallel or curving incisions made at some distance the intervening scalp being dissected completely free from pericranium beneath. In some instances flaps need to be turned in over defects or the employment of radiating

incisions will permit closure. The operator must devise a method to meet every demand. Little attention need be paid to bare areas of pericranium remote from the bone and dural defect after plastic closure; they will granulate over and seldom form an atrium for infection of the distant wounded cortical surface. Following the trimming and irrigation described it is infrequent to find a tendency to hernia cerebri after the early operations.

Postoperative treatment consists of at least ten days complete rest in bed before removal to the base with the exhibition of bromides in sufficient doses to insure mental quiet. If scalp infection or edge sloughing develops antiseptic dressing are indicated.

An examination of the records of the 46 patients on whom craniotomy was performed following gunshot resulting at least in bone lesion disclosed the following facts:

Numerical	46
Deaths	9
Mortality	

Classification made for statistical study of the whole number

Middle meningeal hemorrhage	6
Bone	1
Basal	4
Middle meningeal	5

One patient recovered from his hemiplegia

Apical	4
Posterior	1
Rec	1
Basal	5

Mortality comparisons as to site of wounds of entrance

Posterior	6
Basal	4
Apical	3

A former observation of the author on a series of 75 gunshot fractures of the skull in a base hospital of which 36 were operative gave a mortality of 46 per cent. The results

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of this series of early craniotomies seem to have given a mortality less than half of that a valid argument in favor of early interference. The series is small numerically but as in all branches of operative surgery the work of one operator must alone be weighed to arrive at sensible comparisons. None of these cases operated upon early developed epilepsy while under observation but bromides were given as a routine to all who could take them. The author still believes that occipital wound offer the poorest and frontal the best prognosis on the whole. Consider the variance in mortality where foreign bodies are removed and left in the brain one is inclined to advocate again their early removal. The factor of inaccessibility of foreign bodies must be considered in weighing statistical mortality and may frequently be the reason for non removal. Under these circumstances the injury can be anticipated to be more serious and a higher mortality feared so that statistics fail ultimately to tell the story. From the observation of the head wound on his own service and of those of several other surgeons at the clearing stations the author believes that much dreaded hernia cerebri seldom follows early operation.

Middle meningeal hemorrhage was encountered six times with only one death after operation and ligature. Three of the cases sustained depressed fractures of the skull. It would be reasonable to expect that a much higher mortality would have followed non interference or delayed operations. All the patients except one presented clean cut symptoms of the condition. One interesting instance of middle meningeal hemorrhage may be cited.

It is interesting to note that 75 cases of middle meningeal hemorrhage had a fatal result. Of these 75 cases 36 were operated upon and 39 were not. The results of the 36 operated upon cases were as follows: 16 survived and 20 died. The results of the 39 non-operated upon cases were as follows: 11 survived and 28 died. The mortality in the operated upon group was 55.6 per cent and in the non-operated upon group was 71.8 per cent. The difference in mortality is not statistically significant.

stone three quarters of an inch long which had evidently been blown in. The magnet of course would not effect removal. The patient's right arm had been blown off and because gas infection was present a high shoulder amputation was demanded. Recovery followed.

Bone sinus injuries were found five times. The frontal and mastoid sinuses were involved. When this complication is present with brain injury it seems wiser to perform an early radical operation to avoid possible infection from the sinus lining. There was only one death in this group of patients that undoubtedly influenced by the presence of other wounds. When the frontal sinus connected with the wounded cortical area it was considered best to remove carefully by gentle curettage all mucous surface and to leave small drains to the depth of the sinus.

With four instances of blood sinus injury there was but one death. These sinus injuries are extremely interesting on account of the tremendous hæmorrhage which arises when depressed bone adherent to the sinus wall is removed. On the whole it appears better to leave depressed bone alone under these conditions and to prefer to take a chance on subsequent septic sinus thrombosis rather than to excite an uncontrollable hæmorrhage. Gauze packings or packing with a piece of muscle belly removed under sterile precautions from another part of the patient will sometimes control the bleeding quickly. Another technical possibility lies in inserting fine stitches in the dura about the area which threatens hæmorrhage. A suitable piece of fascia lata with muscle adherent on the under surface is prepared from the patient's thigh. One end of each thread of the dural stitches is then caught around the edge of the transplanted fascia and muscle at proper intervals the depressed bone is removed and if hæmorrhage follows the transplant is rapidly tied into place to control the leakage. The symptom of generalized muscular rigidity so indicative of blood sinus injury was present in two of these patients.

Partial aphasias were quite common. They were for the most part motor (ataxic) and less often sensory. No instances of optic amnesic aphasia nor auditory aphasia (word deafness) were encountered. As expressed elsewhere the author still has doubts about the validity of Broca's speech center in the left third frontal convolution. All instances of aphasia made rapid improvement while under observation and promised ultimate recovery.

Patient No 18 G R 5193 L/Cpl sustained a bomb wound of the head fracturing the skull and penetrating the brain. The author happened to be on duty at the time and saw the enemy plane which dropped the bomb. The patient was received very quickly. After exposing the skull and trephining it was found that the foreign body had penetrated deeply across the base of the brain. The track was irrigated and the finger was unable to palpate the metal at the fullest insertion. While under surgical anaesthesia and apparently deeply relaxed the patient had two severe general convulsions on the operating table following the digital exploration. He made a recovery and never had any postoperative convulsions. Captain Dale M R C U S A made an effort to control these at the time of occurrence by pushing the anaesthesia to the limit but was unsuccessful.

Patient No 46 J P 816 13 I R Prussian German prisoner sustained a gunshot fracture of the right side of the head extending from the posterior temporal region almost to the midline of the vertex which blew away considerable cortical surface and gouged a deep gutter in the brain. The wound was completely trimmed and the scalp tightly closed. He made a most rapid uncomplicated recovery a fact which spoke very well for his resistance and state of health.

Patient No 45 C W C 1814 Cpl R E among other wounds even in all sustained perforation of the brain via the left occipital region. The X Ray plate showed the foreign body behind the left orbit. On following the track through the occipital region it was found to lead directly through the lateral ventricle. The missile was not secured. Recovery.

Patient No 13 B W 44275 Pte gunshot wound right temporal region penetrating with a foreign body lying in the occipital region about the midline within the skull. On following this track the torcular and straight sinus were both palpated at the end of the index finger five and one half inches deep and the foreign body was removed from just in front of the m. The patient made a recovery was under observation seven weeks and has since written a letter from England.

Edgar in his textbook 5th edition says If the foetus has been expelled from the uterus the membranes and placenta remaining behind the indication is to curette at once

In the face of such statements it was therefore essential to find out the course of septic abortion if left to itself

We have had six cases of septic abortion which have terminated spontaneously 4 per cent of the total 156 Our total number of septic abortions is 21 These 6 therefore represent 28 per cent As these cases form the fundamental justification of our line of treatment I may be allowed to report them briefly

CASE 1. Pregnant 6 months Hæmorrhage 12 hours before admission on September 23 Temperature on admission 99.4 pulse 88 September 24 in the morning a fetid foetus was expelled spontaneously Temperature 100.6 pulse 96 In the evening temperature 10.6 pulse 108 September 25 a.m. temperature 99 pulse 88 At 2 p.m. chill temperature 96.6 pulse 40 At 4 p.m. temperature 10.6 pulse 120 At 4.30 p.m. the placenta was expelled spontaneously On September 26 highest temperature 97.6 pulse 88 Puerperium without rise of temperature Complete recovery (See Chart 1)

CASE 2. Pregnant 2 months Hæmorrhage days after patient herself introduced a catheter into her uterus On admission March 24 temperature 103 pulse 120 March 25 temperature 100 pulse 116 Foetus was expelled in the morning In the evening temperature 104 pulse 120

There was slight hæmorrhage for the next 3 days Temperature on the 6th 3 p.m. 120 in the morning p.m. 103 pulse 120 On the 7th temperature a.m. 100.8 pulse 100 p.m. temperature 100 pulse 110 On the 8th temperature a.m. 98.8 pulse 96 p.m. temperature 100 pulse 96 On the 20th temperature a.m. 98.5 pulse 90 p.m. temperature 98.8 pulse 78 no hæmorrhage On the 30th a.m. temperature 97.6 pulse 78 p.m. temperature 99 pulse 96 The placenta was passed spontaneously Temperature afterward 98.6 pulse 75 No further rise of temperature complete recovery (See Chart 3)

CASE 3. Pregnant 4 months Hæmorrhage one month severe for the last 5 days The uterus contains a small fibroid On admission April 21 temperature 99 pulse 88 April 2 a.m. temperature 99 pulse 76 p.m. temperature 98.4 pulse 84 April 23 a.m. temperature 98 pulse 80 p.m. temperature 98.6 pulse 96 Membranes ruptured April 24 a.m. temperature 97.8 pulse 94 4 p.m. temperature 100.5 pulse 112 8 p.m. temperature 100 pulse 111 p.m. foetus and placenta are

expelled Midnight temperature 103 pulse 136 April 25 a.m. temperature 97.8 pulse 92 p.m. temperature 98.6 pulse 88 Normal puerperium afterward

CASE 4. Pregnant 5 months Hæmorrhage one day Admission April 13 Treated expectantly No rise of temperature until April 17 a.m. temperature 97.6 pulse 90 10 a.m. foetus and placenta expelled spontaneously At noon temperature 100 pulse 108 4 p.m. temperature 99.6 pulse 100 April 8 temperature a.m. 98.6 pulse 80 Normal puerperium complete recovery

CASE 5. Pregnant 2 months Chills fever for 5 days previous to admission on June 18 On admission temperature 101.2 pulse 100 On June 19 a.m. temperature 99.2 pulse 88 p.m. temperature 103.6 pulse 116 Three chills On June 20 a.m. temperature 104.4 pulse 100 Three chills A mass of clots and placenta was passed P.m. temperature 97.8 pulse 86 On June 21 a.m. temperature 98 pulse 94 Normal recovery (See Chart 5)

CASE 6. Pregnant 3 months Hæmorrhage one day Packed before entering hospital on May 19th with a temperature of 101 pulse 88 May 20th packing removed Spontaneous and complete abortion In the evening temperature 99.8 pulse 88 May 21 a.m. temperature 99.4 pulse 88 Normal recovery

To summarize Six cases pregnant from two to six months with temperatures before or during the abortion ranging from 100 to 106.6 two of whom had chills during the abortion one of whom had produced a criminal abortion on herself one of whom had been packed before admission were in the hospital one to six days under expectant treatment and completed their abortions spontaneously with complete recovery without any temperature following the abortion

The observation of these cases certainly justified the attempt to carry out the expectant treatment in cases of septic abortion This treatment was carried out in all our cases of septic abortion until some indication forced the abandonment of our passivity

Among our 156 cases of abortion of this series we have had in addition to the six cases described fifteen others which had temperature of 100 or over in the course of the abortion in which the expectant treatment was carried out In these 16 cases it was observed that if the expectant treatment was carried out the temperature always dropped to normal if sufficient time was given and that if after the temperature

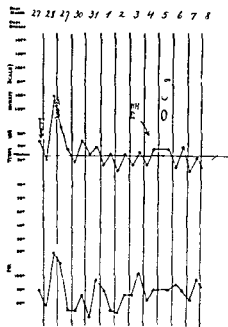


Chart 4 Case 7 F fetus passed
H H severe hemorrhage O operation
Pack packing removed \equiv chill

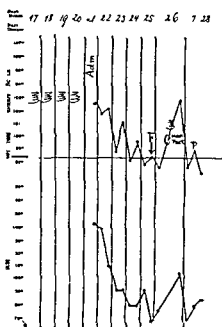


Chart 5 Case 8 \equiv chill F
fetus expelled O operation Man
manual removal P packing re

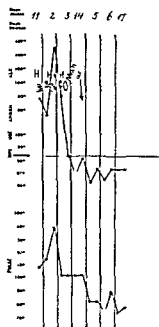


Chart 6 Case 10 H H + H in
creasing hemorrhage \equiv chill O
operation Man manual removed
removed

had dropped to normal the uterus had to be emptied on account of severe or protracted mild hemorrhage this operation could be carried out without causing rise of temperature or at least with very slight and short reaction

Typical cases of this kind may be reported briefly

CASE 7 Pregnant 2 months Hemorrhage one day before admission on May 27 with temperature of 100 pulse 88 Fetus was expelled the same day May 28 a.m. temperature 98.6 pulse 16 p.m. temperature 103.4 pulse 116 Two chills May 29 a.m. temperature 101 pulse 108 p.m. temperature 99.4 pulse 2 Slight hemorrhage and some odor May 30 a.m. temperature 98.4 pulse 2 p.m. temperature 100 pulse 84 May 31 a.m. temperature 99 pulse 68 p.m. temperature 99.6 pulse 96 Slight hemorrhage and some odor June 1 a.m. temperature 98.2 pulse 88 p.m. temperature 99 pulse 72 June 2 a.m. temperature 97.8 pulse 70 p.m. temperature 99 pulse 84 Slight hemorrhage June 3 a.m. temperature 98 pulse 84 p.m. temperature 99.2 pulse 100 Severe hemorrhage Vagina is packed June 4 a.m. temperature 98.2 pulse 80 p.m. temperature 99.4 pulse 88 Packing is removed No hemorrhage June 5 hemorrhage leads to curettement P.m. temperature 99.4 pulse 88 Normal puerperium (See Chart 4)

Under expectant treatment the temperature which had been as high as 103.4 accompanied by chills came down to normal the foul odor of the

vaginal discharge disappeared and when ultimately a more severe hemorrhage required packing and curettement no further rise of temperature occurred

In addition to this case four others were of the same type

CASE 8 Pregnant months Patient had introduced slippery elm into her uterus 2 weeks ago had had chills and fever for 4 days had a purulent

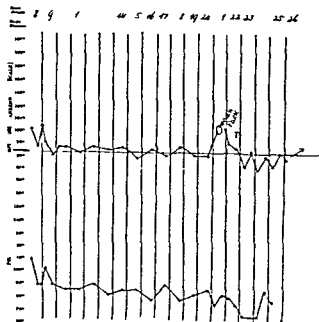


Chart 9 Case 9 O operation M n manual removal
P packing removed \rightarrow patient discharged

discharge from the vagina and a temperature on admission (June 2) of 103 pulse 150 June 22 a m temperature 102 2 pulse 146 p m temperature 102 6 pulse 118 June 23 a m temperature 99 4 pulse 100 p m temperature 101 6 pulse 100 June 24 a m temperature 98 8 pulse 88 p m temperature 00 2 pulse 88 June 25 a m temperature 98 6 pulse 100 p m temperature 99 pulse 76 Fœtus is expelled spontaneously June 26 a m temperature 98 2 pulse 84 Manual removal of placenta on account of hemorrhage Uterus packed Immediately thereafter chill temperature 03 2 pulse 112 June 27 a m temperature 08 2 pulse 78 p m temperature 99 4 pulse 88 Packing removed Normal puerperium (See Chart 5)

CASE 9 Pregnant 4 months Hemorrhage 3 days before admission on April 8th with temperature of 100 8 pulse 108 2 a m chill temperature 01 pulse 88 April 9 a m temperature 99 8 pulse 00 p m temperature 98 8 pulse 88 April 10 the fœtus is passed spontaneously Temperature 99 4 pulse 84

The temperature continued normal until on April 21 on account of hemorrhage which had persisted manual removal of placenta and packing of the uterus was performed In the evening temperature 01 4 pulse 84 April 22 the packing is removed then temperature remains normal and a normal puerperium follows (See Chart 7)

Under expectant treatment in these two and three other similar cases the temperature which had been as high as 103 accompanied by chills in one case following criminal interference with pregnancy dropped to normal and when operative interference became necessary it was followed by a single rise of temperature (in one case with chill) and afterward by normal temperature and normal puerperium

In 5 cases it became necessary to operate while the temperature had not yet returned to normal None of these cases however suffered any damage from the operative interference and in all the temperature was normal on the next day and all had normal puerperium

Case 10 (see Chart 6) is an example of this type

CASE 10 Patient pregnant 4 months Hemorrhage 4 days Two chills the day before admission on May 11 with temperature of 103 2 pulse 106 One chill was observed on the day of admission to the hospital

May 12 a m temperature 102 pulse 112 p m temperature 107 pulse 136 Two chills hemorrhage

May 13 a m temperature 103 4 pulse 00 Severe hemorrhage necessitates manual emptying of uterus and insertion of packing P m temperature 99 pulse 100 Perfectly normal recovery

It is evident from the described cases that the expectant treatment has in no case led to undesirable results in the puerperium which is a great deal more than can be said for the active treatment of septic abortion In years gone by it has been by no means rare in the author's experience as well as in that of others to see cases of septic abortion treated actively and followed by rapid septic symptoms and not at all unfrequently by fatal results We have had no deaths and not one case of puerperal sepsis in this series

Out of the 21 cases of septic abortion described only 7 had any rise of temperature after the completion of the abortion five a single rise and two for two days both of the latter and three of the others having been packed and the temperature disappearing on removal of the packing

Packed cases may as a general rule be expected to show a slight rise of temperature in comparison with cases not packed

While after spontaneous abortion the average temperature was 98 8 there was in cases which had any rise of temperature after abortion the following average temperature after the various operative procedures

	Average Temperature	Number of Cases
Manual emptying of uterus	100 3	5
Curettement of uterus	100 6	8
Manual emptying and packing of uterus	100 8	9
Curettement and packing of uterus	101	3
Combined manual emptying, curettement and packing of uterus	102 5	3

These cases are figured irrespective of presence or absence of fever previous to the completion of the abortion

Though the series is small a slight increase in the temperature in packed cases in comparison with cases not packed is fairly evident Also it is evident that with the increasing severity of manipulation an increase in the temperature reaction goes hand in hand If we simply count all packed cases

irrespective of other conditions we find in 156 cases 23 which had been packed with an average temperature after the abortion of 100.4° the highest (103.6) occurring only once

In the entire 156 cases of abortions 8 or 18 per cent had temperature over 100 after the abortion while the character of the septic abortion finds expression in a higher proportion of cases with fever after the abortion. This proportion in cases of septic abortion is 7 out of 11 or 35 per cent. In 98 cases which had not reached 99 before or during the abortion there were only 3 or 3 per cent which had 100° or slightly over after the abortion.

CONCLUSIONS

From this experience we may therefore draw the following conclusions

Cases of abortion without fever may safely be left to spontaneous termination the only contra indication being severe or protracted slight hæmorrhage

Cases of septic abortion are no exception to this rule. They can terminate spontaneously according to Type 1 (Charts 1 and 2) in which the abortion takes place spontaneously during the fever and the fever drops after the abortion or according to Type 3 (Chart 3) in which the fever drops under expectant treatment and the abortion takes place subsequent to the fall of the temperature.

In cases of septic abortion the temperature may be expected to drop under expectant treatment and if interference becomes necessary Type 3 (Chart 4) of the temperature curve may be observed no rise of temperature after the operation or Type 4 (Charts 5 and 6) a short rise of temperature after the interference followed by rapid and final fall of temperature.

Lastly severe hæmorrhage necessitating evacuation of the uterus in the presence of sepsis may be followed by immediate and lasting fall of temperature (Chart 7)

The foundations for my conceptions of the

pathology of septic abortion are the same as outlined in the above quoted paper on the treatment of puerperal infection of the uterus and do not require repetition.

The treatment which we recommend and carry out in cases of septic abortion is as follows

If a patient with septic abortion is admitted to the hospital expectant treatment is followed until the abortion is completed spontaneously. Rectal examination is used exclusively and that as rarely as possible. The patient is kept in bed and on a light diet. If severe or protracted slight hæmorrhage makes interference unavoidable the uterus is packed. The packing is removed after 12 to 24 hours and frequently the whole remnants of the abortion come away with the packing. If not the packing has usually dilated the cervix sufficiently so that the uterus can be emptied manually. Repeated packing is not favored as dangerous in itself. If the uterus is not empty after the removal of the packing it is emptied preferably by hand if necessary after additional dilatation with Hegar's dilators and if the hand is insufficient with the sharp curette. The longer the interval between the last rise of temperature and the operation the better. Packing afterward is avoided unless necessitated by severe hæmorrhage. The uterus is never irrigated. Ergot is given only when hæmorrhage exists after complete evacuation of the uterus. Vaginal douches are never given until at least a week after the abortion and then only for subinvolution not for purulent discharges. If the temperature is normal after the abortion the patient is allowed out of bed at any time she feels ready unless she is very anæmic. The patient is fed well as soon as possible. The patient is discharged three days after the last rise of temperature unless anæmia, subinvolution etc. require longer hospital treatment. Rectal examination is repeated before discharge.

THE METHOD OF NEW JOINT FORMATION IN ARTHROPLASTY

AN EXPERIMENTAL STUDY

B D B PHLEMISTER M D AND EDWIN M MILLER M D CHICAGO
F m th D p rtm f S ry Rush Medic I C II

THE attempts at re establishment of mobility in ankylosed joints had their origin in observations of two types

The first was that joints with marked temporary reduction in mobility from injury or disease gradually improve with the subsidence of the exciting factor. Passive motion has always been used in such cases to hasten the return of function and especially since the introduction of anæsthesia the procedure has been widely extended to the forcible breaking up of adhesions — *brisement force* — with the re establishment of as much mobility as possible to be followed by active and passive motion in the hope of maintaining most of the advantage thereby gained.

The second observation was in connection with the end results of resected joints. When a limb was ankylosed in an undesirable position as the elbow with the arm extended resection was sometimes practiced and the limb flexed for the purpose of obtaining an ankylosis in a more useful position. Not infrequently such resections were followed not by ankylosis but by the re establishment of considerable mobility in the joint. A similar result sometimes but less often followed resection for the removal of active disease as tuberculosis and infected gunshot wounds of the joints. Thus Textor reported an ankylosis of the elbow operated on at the age of 51 where 6 years later at the time of death there was full range of motion. Ferguson presented before the Royal Society of London in 1861 a 20 year old girl who had almost complete mobility and weight bearing capacity in the limb 5 years after resection of the knee joint for tuberculosis. It was also observed by Douthlepoint Czerny and others at postmortem examination of such resections years afterward that an atypical new joint cavity forms with a synovial lining and in some instances articular cartilage covers the ends of the bones.

These results awakened a lively interest and led to much dispute as to which method of performing resection was followed by the greatest amount of mobility. Ollier Langenbeck made subperiosteal resect in the expectation that the resected part would be partly regenerated and thereby give a better joint. Defontaine performed curvilinear resection of the elbow in order to better preserve the contour of the joint faces. The amount of bone removed varied greatly and in general it was noted that while the range of mobility was wide in extensive resections the joint was apt to be flail and of little use.

After many trials there was still much certainty as to the advisability of attempting resection for the sole purpose of obtaining mobility. At the beginning of the nineties Ollier was about the only one who wrote in favor of it. Hoffa, Lossen and Koenig advising against interference even in case of the elbow when the ankylosis was at a desirable angle.

Such was the situation when Julius Weir made his first report on operation for ankylosis of the elbow in 1895. He modified the procedure to what he termed arthrolysis which consisted in cutting through the bony or fibrous ankylosis in the line of the joint without resecting the ends of the bones. His first operation was performed in 1887 on fibrous ankylosis with a brilliant result, a following this good range of mobility was obtained in cases of bony ankylosis.

In an endeavor to lessen still further the possibility of a recurrence of ankylosis Weir in 1893 began the interposition flap of muscle between the ends of the bone. He was led to the attempt by the observation that in operations on ununited fractures muscle interposed between the ends of fragments was a rather common finding.

L. beck See Losen

first operation was for a recurrent ankylosis of the jaw following a previous resection of the joint. After removal of the condyle of the mandible a pedunculated flap of the temporal muscle was turned downward and sutured into the joint space. The functional result was excellent. This plan of operation was quickly extended to the other joints of the body by Rochet, Hoffa, Nelton, Quenu, Delbet, Schantz, Albarran, and others. Murphy advocated the use of pedunculated flaps consisting of fascia and fat, and subsequently put this method into most extensive clinical use.

The majority of surgeons employing the pedunculated flap claimed that in some way it participated in the formation of the new joint, but there was no uniformity as to the exact method in which this was accomplished. Others claimed that the flap broke down and rapidly disappeared and consequently they began using more durable or non absorbable foreign materials with the idea of keeping the bony ends separated during the formation of the joint surfaces.

The attempts with non absorbable materials such as zinc and silver foil, rubber and celluloid were soon abandoned, but the slowly absorbable prepared animal membranes have been tried out more extensively. Thus Baer interposed chemicized pig's bladder which required from 30 to 40 days for absorption. Cargyle membrane and ammoniac membrane have been used to some extent.

The objection to the chemically fixed membranes has been made that they produce too much tissue reaction. In an endeavor to avoid this and at the same time prolong the durability of the interposed substance Allison and Brooks have used fascia impregnated with non irritating metallic silver.

Since the establishment of the feasibility of tissue transplantations, free flaps of fat and fascia, and of muscle and fascia have been employed particularly in joints about which it is difficult or impossible to secure a suitable pedunculated flap. Kirschner and MacAusland were among the first to advocate this method, although Murphy used it on the knee joint in cases 10 years before but abandoned it for the pedunculated flap.

When the manner in which the new joint forms is approached we find almost as many views expressed as there are methods of performing the operation. It was for the purpose of attempting to clear up this point that the following experimental work was done. Three types of operations were performed (*no flap, pedunculated flap, and free flap*) and the results of each were studied and compared. The theories advanced as to the method of joint formation in each type of operation are given as an introduction to each set of experiments.

There are a number of factors which exert such a modifying influence upon the process of joint formation that they are reviewed in advance of the experiments.

1. *The type of joint operated on.* Experiments were performed on the knee and on the elbow. Since both are weight bearing joints in the dog there is not the difference from static influence which exists in the case of man. However the actual difference in this respect is not very great as in neither instance does the animal use the limb operated on for a number of weeks and the pressure effects result very largely from the tension of the soft parts. In general better results were obtained on the elbows both as to range of mobility and weight bearing. This is because the elbow is a more perfect hinge joint than the knee and particularly because in it a better fitting and more stable joint can be reconstructed after resection.

2. *The condition of wound healing.* This is of great importance. Attention should be called to the great frequency of infection which is attributed to the extensive and mutilating nature of the operations. Out of 89 operations 39 were infected in varying degrees and many to such an extent that they either resulted in death of the animal or were discarded as useless for the study. Gloves were used the skin washed off and the amount of hand contact reduced to a minimum. Superficial infection sometimes occurred without apparent involvement of or influence upon the evolution of the joint. In other instances of outwardly clean operations evidence of deep seated mild infection was detected upon gross or microscopic examination.

In general infection decreased the range of mobility obtained but its presence by no means signified the development of ankylosis as in a few instances fair mobility was obtained despite the existence of a purulent discharge during the first few days. There was more thickening about the joint in the infected cases and consequently a greater tendency for stiffness to progress as time went on. In no instance did a sinus persist after the third week nor extensive infection of the bone with sequestration occur.

3 *Variation in the amount of tissue removed.* The technique of the operations was as follows:

1. On the elbow the lateral incision of Hoehner was used. In the flap operations a suitable layer of the deep fascia was dissected downward with its pedicle over the head of the radius and the joint opened from the side by detaching the structures attached to the external condyle and incising the lateral portion of the capsule without detaching the triceps from the olecranon except in the first six operations which variation seemed to make no difference in the result. The amount of tissue removed from the ends of the bones varied from the articular cartilage and most of the underlying cortical bone in the earlier experiments to rather extensive curvilinear resections of the ends of the bones in some of the later ones. The intercondylar groove of the humerus and the opposing ulnar ridge of the olecranon fossa were preserved in all cases so that even in the extensive resections the joint contour and stability were well preserved. After completion of the joint operation the muscles were reattached and the capsule sutured wherever possible.

2. At the knee joint a curved incision with its convexity downward was made across the front and extended upward on the lateral surface of the lower third of the thigh in case a free or pedunculated flap was interposed between the ends of the bones. The joint was then opened by free incisions internally, externally and along the lateral margin of the tibioapatellar tendon and patella. The patella and tendon were then displaced medially. In the earlier experiment the tibioapatellar tendon was cut, the semilunar car-

tilage and crucial and alar ligaments were excised and the ends of the tibia and femur exposed. As a routine the articular cartilage and underlying bone were removed with a chisel in the earlier cases and a saw in the later ones after which the ends of the bones were reshaped with a gouge, the condyles being rounded off the intercondylar groove deepened and the tuberosities of the tibia leveled off leaving an intervening median ridge running anteroposteriorly and fitting into the intercondylar groove. The articular cartilage of the patella was usually removed with a chisel. In the experiments where it was not removed mention is made of the fact.

In some of the experiments the resection was slight while in others it was extensive. In general the less the resection the greater the stability of the joint. With the more extensive resections the mobility was usually good but the joint was inclined to be flail and useless. The less the resection the greater the flap necrosis. Also the less the resection in well shaped and used joints the greater the cortical sclerosis of the articular surfaces. These points will be fully dealt with later on.

The capsule was always sutured where possible but in the cases where a flap was cut from the side practically no lateral capsule was left in which event the greater portion of the defect was left open. Complete excision of the synovial membrane and ligaments of the joint was not made in any of the experiments. In joints ankylosed by inflammation these structures are found thickened, adherent and contracted and the necessity for their excision in order to prevent rapid recurrence of adhesions has been pointed out especially by Murphy and Payr. Capsule excision was practiced in all of the experiments of Sumita. The necessity of this step does not seem obvious as in these animals the remaining portions are normal and should facilitate rather than impede the formation of a satisfactory joint.

4 *Variation in the amount of function.* This includes weight bearing and motion in both joints and is one of the most difficult factors to control differing widely from our experiences in man where we usually have the intelligent co-operation of the patient.

A silicate of soda bandage was applied at

operation and left on from 4 to 8 days depending on the behavior of the wound. As a rule all dressings were left off by the eighth or ninth day. The animals were allowed to run loose and no passive motion or manipulation was carried out on the joints. Usually little attempt was made to use the joint even in the most favorable cases before a number of weeks had elapsed. In some instances immobilization of the joint was prolonged either intentionally or because of the condition of the wound and it was observed that the longer the immobilization was continued the less the range of motion established. Prolonged immobilization leads to ankylosis although union is much slower about developing than in the case of an ordinary fracture.

5 *The variation with displacements.* A varying amount of displacement was a common occurrence especially in the knee joint and when the resection was extensive. The tibia was frequently displaced backward so that the condyles rode over the tibioapatellar tendon. Lateral displacement and some rotation were also met with and the patella was occasionally found displaced inward. All displacements were detrimental to the restoration of proper function and the greater the degree the more marked the disturbance.

6 *Variation in the substance interposed.* This is of such importance that the 54 experiments studied will be analyzed according to the types of joint spaces that were produced. In the first set of experiments nothing was inserted into the joint space — (no flap operations) in the second set we used a pedunculated flap of fascia frequently containing a certain amount of muscle and in the third set a free flap of the same material.

NO FLAP OPERATIONS

Twenty experiments were studied 17 of which ranging in age from 8 to 128 days were clean and 3 were infected. Six were on the elbow all of which were clean and 14 on the knee joint.

The changes which take place in resections in man followed by movable joints are of the greatest interest here. As previously stated examination at autopsy of such resected movable joints years afterward showed an

imperfect joint with a cavity and bony articular surface covered by fibrous tissue or by newly formed articular cartilage. No one attempted to give a detailed account either from clinical or experimental studies of the changes through which the various portions of the joint go in the process of new joint formation until the work of Hohmeier and Magnus. They performed nine no flap operations on the knee joints of rabbits and in every case obtained stable joints with complete restoration of mobility.

The small amount of experimental work and scarcity of information as to what happens in this type of operation as contrasted with the arthroplasties with interposed substances is to be explained by the fact that since the introduction of the latter procedure the opinion has crept in and has gradually become accepted that a stiff joint almost in variously forms unless some substance is interposed. For this reason the results in this series were noted with particular interest.

NO FLAP EXPERIMENTS

8 day experiment Dog No 3 Elbow joint. Articular cartilage and small amount of cortical bone removed with chisel. Dressed third day. External wound clean. Eighth day died.

Necropsy. Skin closed but incision in capsule open — catgut sutures loosened. No clotted blood in joint cavity. Capsule thickened and apparently inflamed. Articular surfaces smooth and partly covered by a thin layer of either fibrinous exudate or granulations from the ends of the bone. Prominent portions of condyles and ulnar crest bare and slightly polished.

Microscopic examination. Humerus. Transverse section through lateral condyle of humerus shows fairly smooth articular surface. There is a thin layer of necrotic bone along most of its extent which is separated from the underlying living bone by a layer of granulation tissue in which region the bony trabeculae are largely destroyed. The immediate underlying living bone has a fibrous marrow with a small amount of newly formed bone and the deeper marrow is hyperæmic (Fig. 1).

Ulna. Anteroposterior section along ulnar ridge shows smooth surface of bare bone in most of its extent but with thin covering of granulation tissue over one area. Marrow along surface slightly fibrous. No newly formed bony trabeculae as yet.

The joint showed evidences of mild infection in the breaking open of the sutured incision in the capsule and the sequestration of

the necrotic layer by the action of granulation tissue along the surface of the condyle. Aseptic necrotic bone along the surface as seen in other specimens does not become separated as a sequestrum. There was as yet little cortical new bone formation in the fibrous marrow.

11 day experiment Dog No 34 Iliotibial
Tibiopatellar tendon cut. Articular cartilage and small amount of underlying bone removed from all three bones with chisel. No flap used. Dressed third day clean. Died eleventh day.

Necropsy Tibiopatellar tendon united by slender fibrous band. Capsule open anteriorly on either side of tendon. Closed on sides. Patella adherent to femur but movable. Anterior process of joint obliterated. Joint space between femur and tibia.

Tibia Intertubercular ridge has a dense bare shining surface. At site of insertion of anterior cruciate ligament there is a fibrous covering. Surfaces of tuberosities unite. All cortical bone removed. Central portions of the tuberosities are bare. Peripherally they have irregular fibrous covering.

Femur The prominent portions of the condyles are bare and smooth but at the sides especially in front and behind here there is no pressure there are areas covered by fibrous tissue.

Micropsy examination Section anteroposteriorly through intercondylar groove near mesial condyle shows a fairly thick covering over the fairly regular bony surface which consists of fibroblasts except along joint surface where there is a thin fibrous covering which is being replaced by the outgrowing fibrous tissue. A narrow strip of cortical bone had been removed along most of the surface leaving the marrow spaces open. The superficial marrow has become fibrous. Along posterior margin there is an overgrowth of fibrous tissue from the sides. Anteriorly an unusual condition is found. There is considerable ossification of the fibrous covering of the articular surface without any new bone formation in the fibrous marrow of the underlying bone. The newly formed trabeculae radiate from the bony surface and in places extend almost to the surface of the fibrous covering. The fibrous layer is absent in this region and the fibrous layer is thicker than it is along the posterior half and the extreme anterior margin.

The covering of soft parts is in keeping with the fact that the intercondylar region is less subject to pressure and that a fibrous outgrowth can occur. But the ossification in much of its anterior portion is exceptional. There was a prominent crest opposite it on the tibia and the tuberosities appeared to be

considerably eroded from the pressure of the condyles. Perhaps this erosion brought the tibial crest into contact with the intercondylar groove after a fibrous and fibrous layer had formed and the ossification then began in the layer in response to the stimulus.

12 day experiment Dog No 9 Elbow Articular cartilage and most of the underlying bone cortex as removed with a chisel. No flap used. Dressings removed eighth day. Wound clean. Twelfth day died.

Necropsy Incision in capsule healed. Some limitation of motion in joint. Capsule somewhat thickened. Small amount of synovial fluid present. Bony surfaces where subject to pressure bare and shining but about margins and in recesses where there is little pressure there is an irregular fibrous covering. Small area over anterior trochlear surface of ulna with a cartilaginous covering the articular cartilage not being removed.

Micropsy examination Anteroposterior section through lateral condyle shows smooth surface consisting of bare bone along most of the prominent portion of the condyle. Little cortical bone was removed in this region. In one place near the crest of the condyle there is a small island of unremoved cartilage which is being overgrown from the sides by fibroblasts. The surface along the middle portion of the condyle consists of bare smooth bone with a small amount of necrosis in the superficial trabeculae. Superficial necrosis fibrous marrow and here and there new bone formation in the cortical cancellous spaces. About the margins anteriorly and especially posteriorly where there is less pressure there is a surface covering which is fibrous in its outer portion but consists in its deeper portion of fibroblasts growing out from the cancellous spaces of the bone and over from the sides. Cortical marrow fibrous but with no new bone formation.

Much of the cortical bone had not been removed. The areas subjected to pressure were bare and showed beginning cortical new bone formation. About margins there was a fibrofibrous covering with superficial fibrous marrow and no new bone formation.

14 day experiment Dog No 73 Knee joint Articular surface of patella not removed. Fairly extensive removal of surfaces of femur and tibia. Seventh day bandage removed. Wound clean. Fourteenth day killed. Limb not used.

Necropsy There was fifty degrees of motion in joint. Some late mobility. Capsule thickened. Patella mobile. Incisions in capsule healed. Patella and tibial patellar tendon adherent to anterior femoral surface by loose fibrofibrous adhesions. There is a joint cavity between the femur and tibia.

with few adhesions extending across it in intercondylar portions. Bony surfaces of internal condyle and intercondylar groove and tuberosity of tibia bare smooth and slightly eburnated where in contact. There is a loose covering of the articular surfaces about the margins and in the region of the external condyle and tuberosity where there was little or no pressure.

Microscopic examination Transverse section through prominent portion of condyles of femur. The internal condyle and most of the intercondylar groove have a bare smooth bony surface with necrosis of the tips of the bordering trabeculae. Small particles of the eroded bone dust are seen ground into the open ends of the marrow spaces. The superficial marrow is fibrous and there is some cortical new bone formation in the medullary spaces (Fig. 1).

The external condyle which was subjected to little pressure has a fairly thick covering which consists of a fibrous layer along the surface and of a newly formed fibrous layer in its deeper portion. The cortical bone is spongy; its marrow is fibrous and the fibrous covering has grown out from the marrow spaces and is invading and replacing the overlying fibrous layer. There is no cortical new bone formation (Fig. 3).

The tibial surface shows the same changes. The internal tuberosity and crest where in contact with femur are bare and show cortical new bone formation while the external tuberosity has a covering similar to that of the external condyle (Fig. 4).

This experiment illustrates well the early changes in joint formation. As a result of motion a joint space forms between tibia and femur. Where opposing bones are in contact and subjected to pressure the surfaces are bare and becoming sclerotic. Where loosely in contact and free from pressure they have an outer fibrous and inner fibrous covering the latter growing out from the superficial fibrous marrow and gradually replacing the fibrous layer with no cortical new bone formation.

17 day experiment Dog No. 11 Young dog Elbow Considerable bone removed from humerus and ulna. Bandage removed on thirteenth day. Wound clean. Fair joint mobility. Died seventh day.

Necropsy Capsule healed. On opening joint large cavity is present which contains organizing blood clots. The intercondylar groove of the humerus is very deep and broad and has an irregular raw surface. The condyles are narrow and bare along their prominent portions. The capsule is adherent along the sides obliterating the lateral

recesses of the joint. The ulnar surface is almost entirely covered by a layer of fibrin and fibrous tissue. The radial head is covered at the periphery by a fibrous overgrowth. The central portion has a cartilaginous covering.

Microscopic examination A transverse section through the middle shows the surface of the prominent portions of the condyles bare with little of the normal cortical bone removed. In their superficial marrow spaces there is a small amount of new bone formation. At the sides of the condyles the capsule is adherent and osteophytes are beginning to form. Intercondylar groove has irregular spongy bony surface largely covered by a thin fibrous outgrowth from the open marrow spaces. In places bands project from the surface which represent divided adhesions that were in process of formation. No smooth fibrous and fibrinous covering seen in most of extent of joint surface.

Ulna Articular surface has fibrous covering over almost entire extent. Superficial marrow spaces contain a small amount of fibrous marrow and new bone. Osteophytes are found at sides and slight periosteal new bone formation on dorsum of olecranon opposite the joint.

Radial head shows joint surface about sides largely obliterated and a fibrous covering of periphery which has grown out from the bony surface. The island of cartilage at the center of end is overgrown at sides by fibroblasts.

18 day experiment Dog No. 8; Knee Extensive removal of ends of tibia and femur and cartilage from patella. Bandage removed eleventh day. Clean. Killed eighteenth day.

Necropsy Joint mobility considerably limited with limb in extension. Capsule firmly united. Anterior and upper recessus obliterated by adhesions between patella, tibiopatellar tendon and femur. On cutting capsule at sides a small joint cavity is entered between tibia and femoral condyles. Their surfaces are bare at points of contact but have thin reddish covering about margins anteriorly and posteriorly.

Microscopic examination Femur The surface beneath patella has a fibrous covering. There is irregular ossification beginning to extend out into covering from the underlying spongy cortex which has slight cortical fibrous marrow.

Transverse section through the prominent portions of condyles shows a thick fibrous capsule at either side with condylar surfaces largely covered by thin irregular fibrous and fibrinous layer with out any cortical sclerosis. The intercondylar region is only slightly depressed with the old cortical layer of bone present. Its articular surface is bare and polished and there is some underlying cortical new bone formation. It was largely the weight bearing portion of the joint coming in contact with the opposing tibial crest.

Tibia Very extensively resected. The section transversely through the upper end shows epiphysis removed beneath the epiphyseal line laterally and

to just above the line mesally. Tibial crest prominent with bare slight sclerotic surface. Tibial tuberosities have fibrous covering running irregularly parallel to surface. Their bony surfaces are spongy and show no new bone formation.

The tibial crest and intercondylar groove being in apposition kept the more extensively resected condyles and tuberosities apart consequently the former were the weight bearing portions and acquired a bare sclerotic surface while the latter became covered by a fibrous outgrowth from the marrow spaces.

19 day experiment Dog No 10 Elbow Arterio-vascular anastomosis and some cortical bone removed with a chisel. Dressing removed eighth day. Wound clean. Dog died nineteenth day.

Autopsy. Incision in capsule healed. Joint opened. Fat separated. Late lateral recessus obliterated in places by adhesions of capsule to sides of bone ends. Some fibrous flakes in joint cavity. No signs of active inflammation. The articular surface of the humerus shows prominent portion of either condyle bare and dense but anteriorly and posteriorly they are somewhat grooved and irregularly depressed with a covering of fibrous tissue.

Ulnar surface is largely bare especially at the crest and trochlear surface. Laterally the articular surface is depressed and covered by a reddish layer of granulations which seem to be eating in on the side of the ulnar crest. Radial joint obliterated largely about the suture. The end of the radius is bare and dense except in the depressed central portion where there is an all fibrous covering.

Microscopic section through the external condyle of humerus anteroposteriorly. The bare prominent portion consists largely of dense old cortical bone with a small amount of new bony trabeculae. The depressed grooved surfaces have spongy bony walls with a fibrous covering and no new bone formation. This fibrous covering seems to be growing onto and absorbing and replacing the dense bare prominent portions.

This is an instance of the grooving and extensive absorption of the bony surfaces that were not pressed upon while the bare weight bearing portions persisted and showed evidences of sclerosis. The extensive absorption may have been the result of mild infection but other definite evidence of it were not still present upon microscopic examination.

51 day experiment Dog No 54 Knee joint. Moderate resection. Immobilized the entire time. Animal killed.

Autopsy. Very slight mobility. Patella fixed to femur. No special thickening about joint. Longitudinal section through femur patella and tibia shows complete obliteration of joint cavity.

Patella extends down to joint between femur and tibia. There is ankylosis between tibia and femur and the patella by a broad fibrous band which is cartilaginous along the bony surfaces anteriorly. The ankylosis between patella and femur is by a narrow band which is fibrous in its upper portion and cartilaginous at its junction with the broad band between tibia and femur. Epiphyseal lines open (Fig 11).

Microscopic examination. No joint cavity present. The space is a broad fibrous ankylosis between tibia and femur averaging 6 cubic centimeters in thickness. There is an ankylosis between patella and femur the lower end of the patella extending down to the lower end of the femur. The bridge of tissue between patella and femur is fibrous and broad in its upper portion where slight ossification is proceeding from its walls and narrow and cartilaginous in the lower portion where enchondral ossification is proceeding rapidly from both sides. The bridge between tibia and femur is fibrous in its posterior thirds where ossification is proceeding slowly from the spongy bony surfaces largely by fibrous new bone formation. The anterior third is filled by a tissue which is fibrous in its middle portion but cartilaginous along the bony surfaces where it is undergoing ossification by extensive enchondral new bone formation.

The joint in this experiment was treated as in a resection or as a fracture and shows the effect of prolonged immobilization. A fibrous ankylosis occurred with complete obliteration of joint cavity and ossification of the fibrous bridges is proceeding from the bony surfaces partly by fibrous partly by enchondral bone formation.

There is a striking difference between the ends of the bones in this ankylosed resected joint and the ends of the bones in a healing fracture of the shaft showing that the anatomical changes in the two processes are by no means analogous.

55 day experiment Dog No 5 Knee joint. Moderate curvilinear resection. Tibiopatellar tendon cut and sutured. Wound became moderately infected. Wound dressed for 15 days. Range of motion about 45 degrees.

Autopsy. The capsule has entirely regenerated. The patella is firmly adherent by an osseous fibrous union to the femur. The tibiopatellar tendon is thin. The space is a moderate sized joint cavity over either condylar region the limb being held in slight flexion. Between the two compartments there is a loose fibrinous partition. The femoral condyles are largely bare dense and shiny especially over the external one else here they have a fibrous covering. The mesial tuberosity and crest of the tibia are covered by fibrous tissue most of the surface of the

external tuberosity which opposed the bare femoral condyle being bare and dense

Microscopic examination Transverse section through tibia There is marked thickening of the capsule at either side of the joint and ossification by metaplasia into cartilage and bone proceeding from the sides of the end of the bone The articular surface is irregular with a prominence in the region of the tibial spines The surfaces opposite the femoral condyles are covered by an irregular layer of fibrous tissue except over the outer half of the lateral tuberosity where the bony surface is dense and bare (opposite a similar area on the external condyle) The mesial portion of the external tuberosity and the mesial tuberosity are slightly depressed and have a bony surface with slightly increased trabeculae showing a small degree of absorption of the trabecular ends and new bone formation The fibrous covering presents a broad cut surface to either side of the tibial spine representing the cut ends of adhesions to the femur (joint septum) The surface of the joint cavity on either side is extremely irregular and necrotic in most of its extent Mesially there are villi and pockets There is little tendency to ossification of the fibrous covering of the joint cavities The fibers have an irregular radiating arrangement

Transverse section through femoral condyles The same thickening of the capsule and ossification from the sides of the ends of the bone are seen The condylar bony surfaces are extremely irregular There are two deep broad grooves in the external condyle separated by a broad dense bare sclerotic bony surface The walls of these grooves are of spongy bone and show surface absorption The fibrous tissue filling them is mature in its deeper portions and necrotic along the surface An adhesion from the mesial groove presents a cut surface The floor of the intercondylar space consists of radiating fibrous tissue and the sides are of dense bare bone which is newly formed on the lateral wall The mesial condyle is irregularly depressed by absorption of the bony trabeculae The bony surface is spongy and there is evidence of absorption and a little new bone formation The fibrous covering is thick and dense in the deeper portion and necrotic along the surface except about the middle where there is a suggestion of differentiation into a cartilaginous layer

The marked grooving surface absorption and thickening and ossification of the capsule which are the result of the infection favor the occurrence of ankylosis but despite these the ends of the bones show an endeavor at new joint formation

56 day experiment Dog No 33 Knee joint Tibiopatellar tendon cut Cartilage and some of underlying bone removed with chisel Bandage removed on fourth day Superficial infection Healed in 7 weeks Killed after 56 days

Necropsy Animal did not use the joint Range of motion 90 degrees Limb held in moderate flexion extension limited capsule very thick Patella retracted upward as result of giving away of tibio patellar tendon and fixed to femur Anterior recessus of joint obliterated On cutting between tibia and femur a small joint cavity found between condyles of femur and tibial surface Synovial fluid present External condyle in region of joint partly bare and polished partly covered by necrotic fibrous layer Internal condyle and intercondylar groove and upper end of tibia completely covered by fibrous layer There are no adhesions bridging joint cavity but there has been an ingrowth from the capsule between ends of bones decreasing the size of joint cavity

Microscopic examination Tibia Transverse section through articular surface of tibia shows a fibrous covering over its entire extent Bony surface is depressed and spongy over lateral tuberosity and covered by fibrous tissue which runs parallel to surface resembling an adherent flap (Fig 5) The fibers of the covering of the internal tuberosity run irregularly Tibial crest is low and rounded off No new bone formation along articular surface

In this mildly infected joint there was giving away of the sutured tibiopatellar tendon obliteration of the anterior recessus and small joint cavity formation between tibia and femur The restriction of motion was produced by the gradual obliteration of the joint cavity by fibrous ingrowth from the periphery The articular surfaces were overgrown by a fibrous covering except a portion of the external condyle showing the tendency for this to occur where there is in section with little motion and use of the joint The fibrous covering runs parallel to the bony surface in some places and could easily be mistaken for surviving flap in case one had been interposed

55-day experiment Dog No 5 Knee Re section with saw and chisel No flap used Wound slightly infected Daily dressings until the eighth day when the wound was healed Dog killed on fifty fifth day Range of motion 50 degrees

Necropsy Capsule completely regenerated Patella firmly adherent by ossifying fibrous tissue to the femur Tibiopatellar tendon thin Moderate sized joint cavity over either condylar region the limb being in slight flexion There is a fibrous partition anteroposteriorly between the cavities The bony surfaces of the femur are largely bare dense and shiny partly covered by fibrous tissue The mesial tuberosity and crest of the tibia have a fibrous covering the external tuberosity being bare and dense

Microscopic examination Tibia Transverse section. Marked thickening of the capsule at either side of the joint with ossification by metaplasia into cartilage and bone proceeding from the sides of the bone ends. Bony surfaces irregular with a prominence in the region of the tibial spine. Condylar surfaces covered by an irregular layer of fibrous tissue except over the outer half of the lateral tuberosity where the bony surface is dense and bare (opposite a similar area on the external condyle of femur). The mesial portion of the external tuberosity and the mesial tuberosity are slightly depressed and have a bony surface showing a small amount of absorption of the trabecular ends and new bone formation. The fibrous covering shows a broad cut surface at the sides of the tibial spine representing the cut ends of an adhesion to the femur (joint septum). The surface of the joint cavity on either side is extremely irregular and necrotic in most of its extent. Mesially there are villi and pockets. Little tendency to ossification of the fibrous covering which has a radiating arrangement.

Femur Transverse section. Some thickening of the capsule and ossification from the sides of the bone ends. Condylar bony surfaces extremely irregular there being two deep broad grooves in the external condyle separated by a broad dense bare sclerotic bony surface. The walls of these grooves are of spongy bone and show surface absorption. The fibrous tissue filling them is mature in its deeper portions and necrotic along the surface. In the mesial groove an adhesion is attached. The floor of the intercondylar space is filled with radiating fibrous tissue the sides being of dense bare bone which on the lateral wall is newly formed. The mesial condyle is irregularly depressed by absorption of the bony trabeculae. Bony surface spongy showing evidence of absorption and little new bone formation. The fibrous covering is thick and dense in the deeper portions and necrotic along the surface except about the middle where there is a suggestion of differentiation into a cartilaginous layer.

The newly formed joint is a poor one due no doubt to the infection marked thickening and ossification of the capsule favors ankylosis but the ends of the bones show an endeavor at new joint formation.

56-day experiment Dog No. 33 Knee Re-section with saw and chisel. No flap used. Cartilage not removed from the patella. Skin wound slightly infected requiring daily dressings. At end of 56 days fixation is complete extends on to 90 degrees. Patella retracted above condyles.

Necropsy A thin capsule in the region of the quadriceps tendon has formed. The tibio patellar tendon had given away the ends being retracted. There is a small joint cavity present. The anterior and inferior surfaces of the condyles are covered by

a fibrous layer. In the region of the joint cavity the external condyle is partly bare but largely covered by degenerated fibrous tissue. The internal condyle is completely covered by fibrous tissue. The articular surface of the tibia which involves the posterior part of the upper end has been cut obliquely downward and backward and is completely covered by fibrous tissue. The joint cavity is $2\frac{1}{2}$ cubic centimeters wide and 1 cubic centimeter anteroposteriorly. Its lining though irregular is smooth and shiny.

Microscopic examination Tibia Transverse section in region of joint cavity. There is a considerable depression in the region of the external tuberosity. The tibial crest is low and rounded off. There is a fibrous covering varying in thickness over the entire extent of the surface. Over the mesial half and crest it consists of irregularly arranged rather mature fibrous tissue but over the lateral surface there is a dense mature band running parallel to the bony cortex which is oedematous and somewhat necrotic along the joint cavity. The bone is spongy and contains normal marrow in the depressed region of the lateral tuberosity but a thin irregular cortex is forming over the elevated portion. At the lateral margin there is a strip of cartilaginous covering which has evidently formed from unremoved articular cartilage. No osteophytes about the edges.

There is a fibrous covering parallel to a portion of the surface of tibia resembling a surviving portion of a flap but no flap was used in this experiment.

60-day experiment Dog No. 16 Elbow Articular surfaces removed with a chisel. Bandage removed after 9 days. Wound clean. Slightly days range of motion almost complete. Dog killed.

Necropsy On opening through the line of the joint the capsule is found moderately thickened. The joint cavity separated by a band running anteroposteriorly along the intercondylar groove. The cavities are also reduced in size by the ingrowth of fibrous tissue about the margins of the bony ends. The extent of joint surface of the condyles is considerably less than normal due to the fibrous overgrowth from the sides. About half of the remaining portion is formed by irregular islands of bare dense polished bone which are most extensive along the lateral condyle. The other half is covered by a thin layer of fibrous tissue with the cut surface of the partition running regularly along the intercondylar groove. The articular surface of the ulna is formed largely by smooth dense bare bone but about the sides of the ulnar ridge is a rough fibrous covering. The partion runs along the joint between radius and ulna. The articular surface of the radius is partly obliterated in the region of the radio ulnar joint. The surface of the radial end is bare and dense over the mesial part on but has a fibrous covering over the lateral part on.



Fig. 1 No flap 8 day experiment Dog No 3 Moderately infected Necrosis and sequestrum on all left half of surface A New bone formation below on right B



Fig. 2 Knee joint 4 day experiment Dog No 3 Bar condylar surface at point of pressure with 1 fibrous cortical marrow and B beginning cortical sclerosis C underlying normal marrow

Microscopic examination *Humerus* Transverse section through anterior portion of condyles of humerus shows a very irregular articular surface. There is a slight internal marginal exostosis. The prominent portion of the internal condyle has a dense bare bony surface. The intercondylar groove is deep and filled with mature fibrous tissue from which adhesion come off. The external condyle has a thick irregular fibrous covering and has an irregular cortex of newly formed bone. The irregular surface of the joint cavity extends laterally to a little beyond the middle of the condyle. A broad fibrous adhesion is also given off from this surface. The fibrous covering is somewhat villous with degeneration of the projecting masses.

Ulna The surface of the ulnar ridge is composed of dense bare smooth bone on either side of which the articular surface is depressed irregular and covered by a fibrous layer which has a necrotic joint lining except for the cut surface of the fibrous partition laterally.

Radius There are fibrous adhesions about the external surface of radial head where cartilage is removed. Cartilage is preserved where it articulates with the ulna. The surface of the end is bare and polished medially and covered by a fibrous layer running irregularly parallel to the surface laterally. The underlying bone of all of the articular surface contains normal bone marrow extending out to the surface.

There is marked thick fibrous covering of most of the articular surface of all 3 bones. The irregular bare areas at the points of

pressure are sclerotic. Adhesions are numerous. The irregularity of joint surface, fibrous covering and adhesions suggest the possibility of an infection but there were no evidences of it during the healing of the wound.

60 day experiment Dog No 89 *Knee joint* Fairly extensive resection of tibia and femur articular surface of patella undisturbed. No record of length of time immobilized. Wound clean limb not used at the time animal was killed. Mobility slight not more than 15 degrees.

Necropsy There is a small joint cavity between the patella and femur. The articular cartilage of the patella is intact. The tibioapatellar tendon is adherent to the anterior articular surface of the femur obliterating the upper recessus. On cutting between the tibia and femur a thick capsule is found and a small central irregular joint cavity opened into. The tibia is mesially displaced so that the external condyle of the femur overrides the eroded lateral tuberosity of the tibia. The mesial condyle is destroyed by erosion against the tibial crest. There is extensive new bone formation about the side of the tibia forming a ledge beneath the overriding external condyle of the femur. The articular surface of the tibia is formed of irregular ridges and grooves of dense bare bone with ragged fibrous tissue about the margins. The surface of the eroded mesial condyle of the femur has a dense sclerotic bare bony ledge which articulates with the opposing sclerotic tibial surface. The mesial portion of the internal condyle, intercondylar groove, and external condyle have an irregular puffy bony surface with a varying amount of fibrous covering.



$C_{\text{fb}} = \frac{1}{N} \sum_{i=1}^N \frac{1}{d_i} \sum_{j=1}^N \frac{1}{d_j} \sum_{k=1}^N \frac{1}{d_k} \sum_{l=1}^N \frac{1}{d_l} \sum_{m=1}^N \frac{1}{d_m} \sum_{n=1}^N \frac{1}{d_n} \sum_{p=1}^N \frac{1}{d_p}$

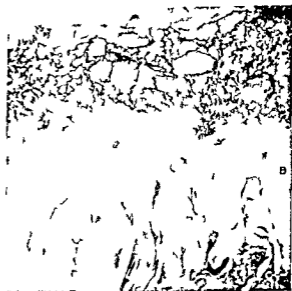
Thus, the joint has the bad influence of subluxation on the mobility and character of joint formation.

E t n i t n f t l a n d f e m u p a t l l
 d u l l D r n g m o v l i g h t d a y
 W u d l L u m l t t l e u e d A l o u t 6 d e
 g e f m t j n t a t t m a n m l k l l d
 V p y T h t l n l p b l e l p l a c e d
 b a k a l u n d n l l g l t e d t a t
 T h t h k n b u p f i e l t e l m i c i o n s
 i n t l a q u e T h t l e c n p a t l l
 a n d f t T h e f a c t t h p a t e l l a s e r l d
 m l l i m t t t l d g n t h u n i r l v g
 f m u r T h t l j a t l l t n l n a l h e n t t o t
 a t r n f i t a c f t h e f n T l e r
 n l j t e i t e t e t h e a t c h l f t l
 u l l t e u l a n t h j o t h l f f t h
 f l t m o r l e n d y l T h e j n t u r f e
 r y g u l T h a d g u l l g e f
 b r u n i n g t e p t l y n t h t l i a h h
 f i t i n t o i l l n g n t l f m u r T h r
 u r f p l l d T l a l e i t h e j o i t
 u r f n a l l n l d b y t b s t s u
 M p t T t n
 t h g l f b n t h p t l l h i b u
 i n g l a l l t t h b o n u r h h j g y a n d
 h s p t a l l e n b r p t n A
 v l l g l n t t h c s l s f t h i t y
 a d i r t i t h m l f a c f t l a t y
 A t t l g l t h d y l c o f t h e
 f n l a d t t h k n g f t l p l
 e n d m l l t t h j t m g T h
 c d l f t h t u r a d p l y g l a n l

The paces are filled with fibrous tissue. The lateral tuberosity of the tibia is like isogrooved and the fibrous tissue fills the defects is adherent to the filling the grooves in the femur thus obliterated largely the lateral portions of the joint. The all of the intercondylar groove and lateral wall of the internal condyle are bare and sclerotic and tubercle with a similar bare dense prominence of the tuberosity. There is small dense bare bony projection on the mesial surface of the lateral nodule opposed by a similar surface on the tuberosity. A slight impression in the intercondylar groove is covered by all menisci. The fibrous lining of the joint is very regular the all are slightly flattened.

There is marked sclerosis of the contacting surfaces but advanced erosion of the condyles and tuberosities and irregular broad adhesions. As yet there is little ossification proceeding from the bony surfaces into the adhesions attached to them. Articular cartilage of the patella largely eroded.

9 d y p nest Dog No 63 A c j int
 A t l a s f a c e r e m c l with croll sa B nd
 a g s m v l n i n t h d y Wound clean T e ty
 fourth d y l i m i s l a l p tell movable Lateral
 m b l t y n l full r a g e of m t i o i n j o i n t L m b
 t u s e d n l k n g Little m i o e m e n t i n f n c
 t n a t t i m e t h e n i m a l a s k i l l c l
 V e c o p s y J o i n t q u i t e s l a l I n c n t h r o g h
 t h c p s u l e h o s J o i n t c a t y b e t n f e m u r
 t i b n o t l a l T h e r c s s u s a b o e t h e p a t e l l



f b 4 N fl i 4 d y f m t D g N 3 S
f t b l p g th t f dy! h F g 3
l l l l B nb l y C m l l y

is obliterated. A large sheet of fibrinous tissue covers the external condyle of the femur and is adherent to the capsule about the femur antero-laterally. This is adherent to the fibrinous covering of the anterior surface of the tibia by a thin fibrinous band. Fibrinous flakes and villi are distributed irregularly over the bony synovial surfaces. In places fibrous organization of these masses is occurring. The articular surface of the femur is covered by a layer of fibrous tissue except the posterior portions of the condyles and the anterior surface in contact with the patella. These are the points of pressure and their bony surfaces are bare, dense and shiny. The surface of the tibia is very irregular. The internal condyle of the femur has eroded the internal tuberosity of the tibia making an irregular groove. The external tuberosity is less extensively eroded. The points of contact with the condyles are dense, shiny, smooth and wavy. A ridge of bone partly covered by fibrous tissue extends along the posterior margin of the point. The tibial crest has been destroyed. Extending inward and backward from the region of the tibial crest on the surface of the internal tuberosity is an irregular surface where the cortex has been absorbed and covered by a deep layer of reddish granulations. The synovia of the capsule is shiny and hemorrhagic. The surface of the patella is bare and rough. There is some overgrowth of fibrous tissue from the margins.

Microscopic examination. Transverse section through anterior surface of femoral condyles above point of pressure. The smooth articular surface is covered by a fairly regular layer of fibrous tissue running parallel to the bony surface. It has a synovial covering at the sides and over part of the external



Fig 6 No flap, 6 day experiment. Dog No 65. Joint surface of femur opposite the patella. Fibrous covering and no cortical sclerosis.

condyle. The rest of the surface at point of contact with the patella and tibioapatellar tendon has a necrotic covering. The bony surface is spongy, with evidence of lacunar absorption of the ends of the trabeculae and a small amount of cortical new bone formation. The normal bone marrow extends out to the bony surface (Fig 6).

A transverse section passing back of the middle of the femoral condyles shows a bare, smooth bony surface with a moderate amount of irregular new bone formation in the cortical marrow spaces.

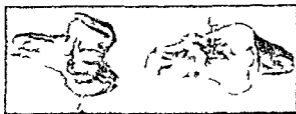
There has been no weight bearing by this surface consequently no sclerosis. The fibrous covering with a modified synovial lining is in marked contrast to the surface in the weight bearing region.

91 day experiment. Dog No 15. Elbow. Fairly extensive removal of articular surfaces. Bandage removed ninth day. Wound clean. Dog used limb in walking and there was full range of motion.

Necropsy. The joint capsule is restored. Practically the entire joint cavity is present. An adhesive band extends from the groove in the middle of the condyle of the humerus to the capsule on the lateral surface of the olecranon. The recessus of the joint about the bony articular surfaces is partly obliterated and bridged by adhesive band. The articular surface of the humerus is smooth and shiny over the greater portion of the condyles (Fig 7). Anteriorly there is a blue transverse streak representing cartilage at its margin. Laterally and about the margins of the internal condyle there is marked



Fig 7 No flap, 91 day experiment. Dog No 15. Joint surface of humerus opposite the olecranon. Smooth articular surface and blue transverse streak representing cartilage at its margin.



F b N f p l b o l m t D g
N Sh g b f t f l B t l t l

l c t u t i t h t a l u r f c e l f b s
v e g i j n t T h r e n r r g u l a r
l o n g t l l l l a t l e s t r n l d y l
i w h i c h t h e a d h i b n d i r m t h e l c r a n o n
i n e t l T h m o l l t y o f t h r d l n r j n t i s
l i m t d A t h t i b u l a n d p t i o n s t f m t h
m a i n j a t a b u t t h e m g n s f t h r a l h e d
M o t t t h r t u l r s f f t h u l a t a
d e n e a n d h v E r o s i o b o u t t h e m r g n s
S o m e r t u l a g p r e s e n t t h e o r o n o i d p
T h s u f c e o f t h r d l l a l i s b e a n d d n s e n
t h e c e n t c o r e d b h b r o s t u a t t h e p r i p h r

M s c p e x a m i n t o n H i n s T a r e
s e c t n t h r o u g h r t i c u l a r s r f c f u m e r u T h
s h n b n y u r f c e l t h e e t r n a l c o n d y l h o c
t l l n d l n o t i l s c e i g (F g 8) I n
t h e g n f t h g e c r t l b n e i s a b e n t
n t h e t f i k f i r o c o r i g h c h i c n t i n u u s
u n t h e u n l e v i n g n a r p O v t h e
t r n a l o n d y l e n d i n t e n l v r g t h r c a
f i b u s c e r n g t h v l t l c t l c l o i
(F g o) T h u l l v i n g m r r i s t i b r u s
E d e t h t h e f i b r m a r r o l c h f m l h r
h a s b e p l c e l b y t h n m l m a t u e
T h e p c s b t h t l d n l a c t x
i s t b t b u

O n t h l i a t l d c e t l b o n y f i
b d m o o t l T h c l e v i n g m p c s
a m a l l d s l g t l y t b u s A t t h m a g t l
b v u t a e d p e d a l r l b y t h c k
l a y r f i b u s t u e l h i n t u o u t h t e
c a p u l I t t e d l g h t l y t t h l e v i n g
m r i S m a l l t p l t r e e b o u t
t h m r g n d t l r o m e p s t l e b o n
f o t i o n a l n g t l d

This is a fairly well constructed new joint
showing typically the two varieties of articu-
lar surface which may form

I o d v x p i c t D o N j o K c A
t u l a r r t u l a g a n d m d r t e a n t i b e
r e m o v e d i t l a s a N l l p u l L g h o u t
i m o b i l a t i n n o t a c c u t l y r d d W o u l d
l a n A t n d f o l y s l u t o d g s o f
m o t i o n L g h l d i l i l a t l l b o u t i
n c h a b o v e l e f t h e j t a l i f d
A p v O p g t h e j o i n t i t r
f o u l m t l e g n f t h e c o i l e T i b a l c r s t



I g 8 N f l i o d v i m t D g N s
J i f n b d b j l l m t f E t j
l y l f l m

I o s e l y a d h r e n t t o t h e i n t e o n l y l a g r o o e o f
f i u r A t h i c k t b o u c v e g e m r g n s f
d y l e s a n d n t r c n i l r g r o o e h c h a p p r e n t l y
h a s g n i n f o m t h d C a p s l e a d h e n t t
t h e a n t r i o r s u f o f t h e f m r U p p e r e c s s
o b l i t t e d T h e p r o m e t p o t r i s u r f o f
t h c o n d y l e i s l a i r r g l a l s e l e t i c T h r e
n r k e l g o o v g n l u n l e m i g b y t h e f i b r o u s
t u a b o t t h i r m g F i b u o n b e t e n
p a t l l a n l f m u l b a l c r t l l m r k e d b u t
i r g u l a r T l m a g n f t h e t u b e s i t e r e
c v e d b y t b u s t s e g r t f m t h e c a p s u l
T h i e t s a r b a e l l i e s c l e t c b
c o r t e h l o m e d p t r t h h t h e o t e i s
t n a b y g l a t s s m e l i p p i g a b u t
t h m a g n f t b a

M c p e s n a t i T i T r a n s r e c
t i n M d e a t e l y t h n f i b r o u s e r n g m t
o f a i a l y r g l j u n t s u f a c C r i n g r a g d
r g u l i n p a l l t o t h b o v u r f a c e S f c e
o f t e l h l f e t c n a l t u o t y f r m e d b y d n e
l u r b N j u t v i t y l t e r l t i t C t
r f a f d h e n s a e s e e n a b o u t t h l c r t A
h a p c l r t b a e p m e e l o t m d l l f
l t u b e t y l h e c t f t h e s f e s
l g h t l e p s l n l h s p g b o v l g
l h s l s l g h t t n d e n v t s y f i c a t n f t h e
c o g A l g t h t i b l e r e s t n e a t n f t h
t t c h c t f t h a d h e e l n i l a s t k n j l a
T h e m e f e a t o f t h t h i k e e l a p s l e
a t t h i d s

F i T n s e e t t h g h o d y l e s I
e g u l a c n d y l a u r f c e i t h n u m b r f s m l l
g r o e i l l d t h f i b u s t u e t h r i n g
r i d g e b i n g f l a e d e e b e I t e r c o n l y l a
g o c o e l l y t b o u s l y r g n g o f f n
a d l o n t t h t b i a l s t S l i g h t o s i f t o f



Fig. 9. No flap 91 day experiment Dog No. 15
Internal condyle Fibrous covering with light cortical
bone formation

the fibrous tissue filling the grooves is occurring along the surface. Fibrous covering along internal condyle shows a tendency to differentiation into an articular cartilage.

Capsule thick, adherent to femur anteriorly and has a tendency to ossify. Slight tendency to ossification of the fibrous coverings of the joint surfaces but also a tendency of the same to change into articular cartilage. Despite these features a fair degree of mobility was preserved.

10 day experiment Dog 45 Kne Tibio patellar tendon cut to expose the joint and later sutured. Resection made with a saw. Limb immobilized 2 weeks. Wound clean. Limb not used in walking. At end of 10 days only 10 degrees of motion.

Necropsy. Femur and tibia united by a firm thickened capsule. On cutting through the line of the joint two narrow dime sized cavities are found in either condylar region separated by the tibial crest which fits into the intercondylar groove along the middle portion of which is a small cavity communicating with that over the median condyle. Anteriorly and posteriorly there are exostoses from the ridge on the tibia and fibrous adhesions to the femur. The patella is displaced three fourth inch upward and has a bony union to the femur. The upper recess of joint is completely obliterated. The articular surface of the femur is partly covered by fibrous tissue which has apparently grown in from the capsule and partly by granulation tissue



Fig. 10. No flap 18 day experiment Dog No. 6
Fibrous covering of condyle of femur after ten days
section. Flap joint with little pressure

which seems to have come from the bone marrow. The cortical surface is very dense and bare over the condyles. The depressions on either side of the crest are very rough and covered by granulation tissue which seems to have come from the underlying marrow. The entire capsule is greatly thickened and hard in places having the consistency of bone and forming a rim about the margin of the joint.

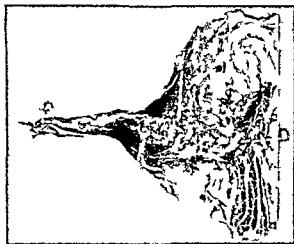
Microscopic examination. Femur. Transverse section through condyles. Marked fibrous thickening about the sides of the joint with an independent center of ossification on either side. Slight periosteal proliferation along side of lateral condyle. The joint surface extends laterally into fibrous tissue beyond the bony limits where the lining is thickened irregular and necrotic. The inner portion of the mesial condyle is made up of irregular jagged spongy bone covered by an irregular fibrous layer. The joint surface is interrupted mesially by a fibrous band in the rest of its extent it is very irregular and necrotic. No semblance of an endothelial lining. Underlying spongy bone shows ossification advancing into the fibrous covering in a few places as if attempting to form a continuous bony cortex. At the lateral border of the condyle the bony surface is bare and sclerotic. External to this at the margin of the intercondylar groove the surface has a fibrous covering with a spongy bony cortex forming below. The middle of the intercondylar groove is dense bare polished bone the superficial cells of which have broken down leaving the lacunae vacant. External condyle somewhat more depressed than the mesial. It has a thick fibrous covering over its mesial portion with underlying



Imm b l l t pe l s l l l p k k l

spo gy b n th t t r d r f urfa pro
life u The nb s e n s v l d e
n att the o c and t m l y n e r t i c a n l r r g l a r
a l g t h u r f a c Th r i s h r p b o n p r j e c t i o n
t h b e d e t e t t h e t f t h e n d y l e
E t r n a l t o t h t h i s g o v e n t h c o n d y l
r l b n l o u t u e t h f l o o r o f v h u c h h o v s
o t t Th l a t l m a g n f t h e c n d y l e f
b a d e n b c

A joint cavity is still present in spite of almost complete ankylosis. Marked tendency toward thickening of the capsule and lipping. At places of pressure the cortical bone becomes smooth dense and shiny. The fibrous covering has mostly grown out from the marrow spaces. Little tendency to ossification of the fibrous covering.



l k 3 P l lat d f l o d y l m t D g
N T u l h p e d p e d l f f l p t h t p e
l f h h l a y b t t h d d t l d y l
B B l b t m j d

I g I l l t l f l s l l m t D b
N 48 S t t f t h m b l g f l p l g
t h t t b l d h f t l t d s f m p e
f t t t t h t i

128 d v c p c t D g v o A e E
t e n i e r e s c t i o n l a t e l l a n t d t b e d N o f l a p
u s e d B n d g r m o v l o n s e v e n t h l a y W u n d
c l e a n L m b l l t t l e u d R n g o f m o t i o n a b o u t
30 d g r e s

v p v J o i n t f l a i l I a d a n d b a k a d
d i s p l a c e m e n t f t h t b a b r i n g i n g t h e e t e r n a l
c o n d y l e o f f e m u f o n t f t h h u l a n d t h e i n
t e r n l c n d y l i n b a c k f t h t b o p a t l l a r t n d o
A j o t a t y l e d i t h a o u g h l l o u g r n l a t g
s u r f a c e f d E n t i r e t i b a l s f a c e c e d b y
a r u g h h b s l y c r S m a l l i s l a n d s o f e b n a t e d
b o n e n a c h t u b e t y T h r i s a f i b r o u s c v r
i n g e r l l o f t h e f e m o r l s u r f c e e x c e p t a s m a l l
p r j e t g r o v e t h e n t r n l c o n d y l e h r e t
i n c o n t a i n t h t b a E a t r n a l c o n v l
h c h i s f c e f r o m p e s s c o d b y l o o
g u l a t i o n N o c a v i t y h e

M e r s c o p i c a n a l y s i s F e t T r v c s e
t o n t h o u g h c n d y l T l a n v n j i n t s u
f a c e r l i n t h c n l y l a g s b y a t h i n f i b r u
l y (f g o) O r t h e i n t r n d y l r g r o o c e l l
f i b r o u i n g m u c h t h k e r a n l p e s n t s t h e
c u t s u f f t l l s t e b a l s T h r i s o n i d e
l l f i b r o u s c l t a n l f g n i n g t g
a l n g t h u r f c e f t h j i n t I n t h e p l h e e
t h l s s y e r a s a l g t h e d f t h d
h o t h i s o t f s y n o v a p e t T h e t l
l n p k y n l s h s l i t t l e e b n t m t
n l m l l p t o f t h e s p l t b c u l a e
l o n g t h e n u r f c e x c e p t a t t l e m l d f
t h n t n l c d y l e h r e a b a d e n p u l
p r j e t T h j t i n g c t h p l t i t h r
s i l u n n a n d f r m e l l a g l y b y t t i s s u
c o d b c a u d t

The joint is fluid. There is a large joint cavity extending up above the patella. The walls are very shaggy with much fibrous exudate. This shows particularly well the changes which occur when the limb is not used for weight bearing. There is a fibrous covering of almost the entire bony surface and no sclerotic cortex except in one or two small areas over the internal condyles. The



Fig 14 Pedunculated flap 5 day's permanent Dog No 51 Magnification of flap which as not compressed. Deep portion of flap shows superficial necrosis



Fig 15 Pedunculated flap 10 day's permanent Dog No 5 Edge of flap bordering on perforation shows necrosis

condition of the joint is much like that to be expected following arthroplasty in the upper extremity of man

RESUME OF CHANGES FOLLOWING NO FLAP OPERATIONS

In reviewing the group of experiments it will be seen that the changes which occur in the average joint according to age and the previously enumerated modifying influences are somewhat as follows

From the operation there is extravasation of blood into the cavity which partly fills the recesses and covers over the necked ends of the bones except at the points of contact and pressure against the opposing bone where it is either prevented from deposition or is eroded by motion. The incisions in the capsule heal rapidly and any defects as in the lateral portion of the knee in case of the flap operation are very rapidly repaired. The bone marrow along the joint surface is quickly transformed into fibrous tissue and the cells of many of the traumatized surface trabeculae undergo necrosis and absorption. The transformation continues and varies in the different parts of the joint according to the presence or absence of pressure upon the bony surface

Where there is absence of pressure a fibrous covering rapidly grows out from the open spaces of the ends of the bones and gradually replaces the layer of resolving blood clot (Figs 3 and 4). If early motion is established a joint cavity will be maintained and there will be no adhesions between the opposing fibrous surfaces. There is a wide range in the thickness of this fibrous layer. In general the wider the separation of the bony surfaces the thicker it will be and it is especially apt to be marked in the intercondylar groove and about any rounded margins and recesses which are practically free from pressure. The cortical bone of such regions shows no tendency to sclerosis the marrow spaces remaining open. The ends of some of the superficial trabeculae as a result of the traumatism undergo necrosis and absorption.

Over the prominent portions of the condyles and tuberosities which are in contact with and subject to pressure by the opposing bone the surfaces remain bare and become smooth from the wearing away by friction of the uneven projecting trabeculae (Fig 5). Some of this bone dust is ground into the open intertrabecular spaces along the surface. New bone formation occurs and goes on rapidly to



Γ t I l l l l l l l l l m t D h
N K j t p i l l l l d d n t h
f t l l l l m l j j k l B t
l t l f t l d l n T l h l k
l h l l l m m k l l t l c
h l t h l l l p

the formation of a dense smooth cortical layer which becomes the supporting or weight bearing portion of the joint. The more extensive and perfect the contact of the bony ends the greater the range of motion and the less extensive the resection the greater the area of bare bony surface will be. The extent of this smooth dense bare surface is variable. It is greatest where the resection is least the contact between the ends broad and perfect and the mobility marked.

The two types of surfaces are well marked by the end of the third week. The subsequent change are somewhat as follows:

1. In the region subject to little or no pressure the covering of fibroblasts gradually change into mature fibrous tissue. The intertribecular spaces near the surface usually become refilled with normal bone marrow. The cortical bone remains spongy and not infrequently grooves filled with fibrous tissue form. Where pressure is absent the cells and fibers may be arranged parallel to the surface and resemble very closely surviving portions of an interposed flap (Fig. 5). With time and usage the various portions of the joint surface approach more nearly the same level and the area with a fibrous covering are subjected to more pressure. This produces a variety of changes in the fibrous layer. The superficial portion becomes more or less necrotic with few nuclei and faint staining properties. The deeper portion shows little

necrosis but the arrangement of the tissue is altered. The cells and fibers are either irregularly distributed or radiate at right angles to the joint surface decreasing in frequency and staining power as the surface is approached. In the older experiments this change had advanced to the point where an imperfect articular cartilaginous covering had formed (Fig. 7). Villous tips are frequent about the margins and from the capsule and are sometimes found attached to the articular surfaces of the ends of the bones.

A variable number of adhesions are formed. For the most part they are about the edges in the joint recess and along the intercondylar groove in which case they may partition the joint cavity. The upper recess of the knee joint is usually obliterated or a separate cavity may be left between the patella and the femur but the surface always have a covering of fibrous tissue without sclerosis of the underlying cortex as the pressure in this region is not sufficient to produce the scleroed bony surface (Fig. 6). Sometimes a fairly good endothelial lining is formed especially along the surface of the adhesions and pockets where there is no pressure (Fig. 8).

The changes in the bare and scleroed areas are variable. With age they usually show a tendency to decrease in size being gradually absorbed about the margins and replaced by the overgrowing fibrous layer. However this change is usually a slow one and none of our experiments were sufficiently old to show the completion of the process. In some specimens the areas were stationary as no evidence of replacement or spreading could be detected upon microscopic examination of the junction of the fibrous and bony surface. Sometimes actual spread of the scleroed area was seen about portions of its margins.

The joint cavity was practically always decreased in size especially in the case of the knee joint. The capsule was usually thickened and exostoses were present about the joint margins especially at the insertion of the capsule. Where resection was fairly extensive weakening the articular portion of the ulna or the condyles of the tibia considerable new bone formation occurred along the periosteal surface of the end.

The range of motion varied with the various factors enumerated but in general it was considerable. It was most marked in the elbow as in the 60 day experiment Dog 16 where it was almost complete. The results were much poorer on the knee although fair mobility sometimes resulted as in the 91 day experiment Dog 15 where the animal used the limb. Where extensive resection of the knee was performed wide range of mobility but a flail and useless joint was usually obtained. Prolonged immobilization completely altered the picture as shown by Experiment No. 54 51 days old where there was *complete fibrous and forming bony ankylosis* (Fig. 11).

Infection interfered with the new joint formation but when mild was not incompatible with the establishment of a certain amount of motion.

PEDUNCULATED FLAPS

Helfferich who first used the pedunculated flap did so with the hope that the interposed muscle would remain alive and inhibit the recurrence of ankylosis. Little experimental evidence as to the behavior of the flap was offered by those who early extended this method of performing arthroplasty. Murphy and Neff thought from a very few experiments on dogs that a kind of bursal sac formed in the flap the walls of which became attached to the ends of the bones and formed the lining of the joint.

Iyer advanced the theory that the joint cavity forms in the flap from degeneration and hemorrhage into its central portions after the method described by Ledderhose for the development of a ganglion. Smaller cavities arising in this way become confluent and form one large joint space. Sumita working under Piers' direction thought he confirmed the theory by experiments on animals.

Allison and Brooks in a very careful study of the fate of various substances placed in the upper recessus of the knee joint between the patella and femur found that pedunculated flaps except a small portion of the pedicle broke down and were completely absorbed within a short time. The articular surfaces of this region which had been denuded of cartilage and bony cortex were rapidly cov-



Fig. 7. Pedunculated flap 42 day experiment Dog No. 73. Covering of condylar surface not derived from flap.

ered by a layer of fibrous tissue which grew out from the marrow spaces. No new bone formation occurred along the surface in any of their experiments. They made the mistake of assuming that the changes in the entire joint were the same as those occurring in the upper recessus without taking into consideration the differences in function and pressure to which this and the tibiofemoral portion of the joint are subjected.

Hohmeier and Magnus experimented on the knee joints of rabbits and concluded that the pedunculated flap survived and became attached to the ends of the bones splitting through the middle portion and forming a new joint cavity within its substance.

Thus we see that there is wide variation of opinion as to the part played by the flap and little information about the changes which go on in the articular surfaces of the bones.

PEDUNCULATED FLAP EXPERIMENTS

Fifteen experiments were performed 8 of which were on the knee and 7 on the elbow. Five were infected in varying degrees.

5 day experiment Dog No. 48 Knee. Tibio-patellar tendon cut and resutured after an extensive resection of the joint and the interposition of a pedunculated fascial and muscle flap between femur and tibia and femur and patella according to the technique previously described.



Fig. 1. S. P. d. l. t. d. f. p. 4. d. y. p. e. m. t. D. g. N. 8. H. p. l. l. d. l. t. d. t. l. f. f. t. b. t. b. j. t. i. t. p.



Fig. 2. l. g. o. l. d. n. l. t. d. f. p. 4. d. y. p. e. m. t. D. g. N. 8. H. p. l. l. d. l. t. d. t. l. f. f. t. b. t. b. j. t. i. t. p.

D. killed n. f. f. l. day. In g. i. n. g. the ether the j. t. p. u. l. l. e. d. p. n. Th. t. b. o. p. a. t. e. l. l. a. r. t. n. d. n. h. a. l. p. e. i. o. u. s. l. g. n. a. v. n. d. e. t. a. c. t. e. l. l. e. p. a. t. e. l. l. a. u. j. d.

V. p. v. Th. f. l. p. n. d. e. the p. a. t. l. l. s. i. n. t. a. c. t. Th. u. f. e. f. i. l. f. s. m. o. s. t. l. y. b. a. e. i. n. p. l. g. a. u. l. a. t. n. r. g. o. i. n. g. o. u. t. Th. e. f. l. a. p. r. the t. b. i. a. i. n. t. a. c. t. l. a. i. d. d. t. f. i. t. the p. c. e. b. t. e. e. n. th. t. o. b. n. T. o. d. p. e. n. s. i. t. l. n. c. o. s. i. s. f. t. h. f. l. a. p. a. e. s. e. n. t. p. n. t. s. o. f. p. r. e. s. s. u. r. e. f. r. o. m. the d. v. l.

M. c. p. e. x. a. m. i. t. S. e. t. i. o. n. o. f. f. l. a. p. l. e. a. n. e. a. t. h. f. i. l. l. n. o. t. h. e. t. o. p. a. t. e. l. l. a. g. h. a. n. d. n. t. n. x. t. o. t. h. e. f. e. m. u. l. t. c. m. j. d. o. f. d. e. t. b. b. l. n. t. s. c. e. n. t. r. a. l. p. t. c. m. j. d. o. f. d. m. e. r. i. c. h. l. y. l. l. l. a. r. s. t. r. u. c. t. u. r. e. p. u. g. h. l. l. y. C. n. d. e. a. b. l. n. s. i. s. s. e. e. n. t. h. r. o. u. g. h. o. u. t. the f. l. p. t. l. l. l. a. r. p. r. i. f. i. c. a. t. i. o. n. e. p. c. l. l. y. a. l. o. n. g. th. u. t. a. e. t. t. o. t. h. p. i. t. e. l. l. a. M. o. s. t. o. f. the b. l. o. d. e. e. l. m. a. l. i. v. b. u. t. c. a. i. n. a. n. o. c. l. i. s. N. o. h. e. m. r. r. h. e. s. a. i. t. s. r. e. s. a.

A. s. e. c. t. i. n. s. t. t. r. a. n. s. e. r. l. y. t. h. r. o. u. g. h. the f. l. a. p. e. the t. i. b. i. l. e. s. t. f. o. m. o. n. e. n. c. r. o. t. i. c. a. a. t. o. the o. t. h. e. (F. g.) Th. e. f. e. e. s. u. r. f. c. e. f. the f. l. a. p. s. e. t. c. a. n. d. c. o. e. d. i. t. d. b. i. Th. e. t. i. b. i. a. l. s. f. a. c. s. d. h. e. e. t. t. o. the b. e. a. n. d. p. a. t. h. l. y. a. l. e. the m. s. c. l. e. c. n. t. e. n. t. n. the r. e. g. n. s. h. n. g. n. e. c. r. o. g. i. b. e. s. i. t. l. l. p. r. e. e. d. n. d. h. y. p. e. r. t. r. o. p. h. y. g. i. t. t. i. t. l. t. e. O. l. d. c. p. l. l. n. d. s. m. a. l. l. b. l. o. d. l. r. n. the m. i. d. l. l. f. the f. l. a. p. f. i. l. d. w. i. t. h. i. l. m. o. u. s. u. d. a. t. e. N. t. t. o. t. h. b. o. e. f. e. a. d. g. c. a. p. l. a. r. i. a. r. p. r. e. e. t.

The specimen shows how the flap breaks down in its entire thickness at points of pres-

sure also how the flap becomes attached to the surface of only one bone. The nutrition of the surviving portions of the flap is not preserved through the pedicle but by vascular ingrowth at its new attachments. An anteroposterior section through the mesial condyle of the femur shows a bare somewhat polished spongy surface with a superficial fibrous marrow. The cells of the superficial trabeculae are necrotic.

S. d. a. y. a. p. e. n. t. D. o. g. N. o. E. l. b. a. L. t. e. r. l. i. n. c. i. s. i. o. n. T. r. e. c. p. s. t. e. n. l. o. n. n. t. u. t. P. d. u. c. u. l. a. t. e. d. f. l. a. p. i. n. t. e. r. p. o. d. f. t. r. r. e. m. o. v. a. l. f. r. t. i. l. a. r. u. f. a. c. s. W. u. n. d. i. n. f. t. d. d. r. e. s. s. e. d. d. a. i. l. y. D. i. e. d. g. h. t. d. y.

V. e. c. p. v. A. n. o. p. e. n. g. u. b. c. e. t. m. e. t. e. r. l. o. n. g. l. e. a. s. i. n. t. o. the j. u. n. t. m. i. l. l. e. o. f. c. i. s. i. n. C. a. p. u. l. s. w. o. l. l. Th. e. f. l. p. h. a. s. c. e. t. r. l. y. d. s. a. p. p. e. a. r. e. d. e. c. p. t. f. o. r. a. m. l. p. t. o. f. the b. a. s. a. b. o. u. t. i. c. u. b. i. c. e. n. t. m. t. r. l. n. g. d. c. u. b. i. c. c. e. t. m. t. e. d. h. c. l. s. d. i. c. s. l. a. p. d. n. d. a. p. p. e. a. r. s. n. e. c. r. o. t. i. c. a. t. i. s. m. a. r. g. n. A. b. o. u. t. the p. r. i. p. h. e. r. y. o. f. the j. o. i. n. t. g. n. u. l. a. t. i. o. n. s. r. e. g. r. o. w. i. n. g. u. t. f. r. o. m. the c. a. p. s. u. l. e. A. t. t. i. c. u. l. a. r. s. u. f. c. m. o. t. h. l. y. b. a. r. e. a. n. d. o. g. h. f. m. l. l. g.

M. i. c. r. o. s. c. o. p. e. a. s. a. t. i. o. H. n. r. i. s. T. a. n. s. r. s. e. c. t. i. o. n. t. l. o. g. h. m. l. c. o. n. d. y. l. e. A. l. o. n. t. h. a. t. t. i. c. u. l. a. s. u. f. a. c. e. the b. o. n. e. b. a. r. L. e. u. c. o. c. y. t. n. f. i. l. t. a. t. o. n. a. d. o. m. e. n. e. c. r. o. f. the t. r. a. b. e. c. l. a. e. d. b. g. i. n. n. g. f. i. b. r. o. s. s. f. s. u. p. r. i. f. i. c. a. l. b. e. n. e. m. r. o. M. e. s. a. l. l. y. h. e. r. e. f. r. e. e. f. r. o. m. p. r. s. s. u. e. the s. a. t. h. i. n. c. o. v. e. g. o. f. g. r. a. n. u. l. a. t. i. o. n. t. i. s. s. u. e. t. h. l. i. g. h. t. l. y. f. i. b. r. o. u. s. m. o. n. d. a. f. e. n. e. l. y. f. i. m. e. d. b. y. t. a. b. e. c. l. a. e. n. t. h. u. p. e. b. l. m. a. r. o. s. p. a. c. e. s. C. o. n. s. i. d. e. r. a. b. l. e. c. o. r. t. i. c. a. l. n. e.

The findings are very similar to those in infected 8 day experiment No. 8 in which no flap was used

9 day experiment Dog No. 5 Elbow Articular cartilage removed with a chisel from entire bony articular surface the triceps tendon having been cut to facilitate exposure. A pedunculated flap of fascia from the lateral side was reflected over the radius and ulna and sutured at its margins. Wound clean. Dog died on ninth day.

Necropsy Interposed flap adherent to the capsule about the entire circumference of the articular surfaces. About two thirds of its central portion is broken down. The remainder is represented by a reddish debris which is closely adherent to the articular surfaces. The living peripheral portion of the flap thins out as it approaches the central necrotic portion similar to a semilunar cartilage. The living peripheral portion of the flap is easily separated from the ends of the bones. The portion of the flap in the coronoid fossa is necrotic.

Microscopic examination Triangular shaped section was excised laterally through pedicle of flap at the side of the joint and through the surviving marrow portion extending inward for a short distance between the exterior condyle and the radial head (Fig. 13). The flap is broad toward the base where it is attached to the capsule gradually narrowing toward the apex where it is necrotic and somewhat hemorrhagic. As the base is approached it becomes less necrotic until near the capsule most of the flap is alive and is being invaded by a rich network of fibroblasts and invading capillaries from the capsule.

A transverse section through the condyles shows the humerus covered in the intercondylar region by remnants of a thin necrotic flap held in position by a fibrinous exudate. The condylar surfaces are bare. As yet there is little cortical proliferation. The superficial marrow is fibrous.

The flap has nearly all broken down and the condition of the ends of the bones is practically the same as in a no flap operation.

10 day experiment Dog No. 51 Knee Tibiopatellar tendon cut and sutured. Dog had distemper. Killed tenth day. Wound clean.

Necropsy Wound clean. Incision in joint capsule healed. Tibiopatellar tendon reunited by a thin band of granulation tissue. The joint is opened through the previous incision. The remnants of the flap are adherent to the femur about the margins and along the intercondylar groove. Over the tibia there are two depressions in the flap at points of contact with the condyles which are separated by the ridge of the tibial crest. The flap is necrotic over an area 2 cubic centimeter in diameter over the lateral tuberosity and very thin and partly broken down over the mesial tuberosity leaving a small perforation. The remainder of the flap

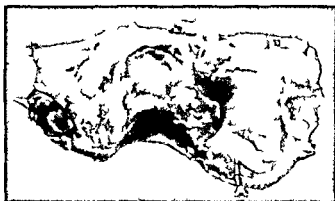


Fig. 20. Pedunculated flap 161 day experiment Dog No. 3. Elbow joint opened from front showing smooth bony surface without arthritis and surviving pedicle of flap over edge of external condyle.

seems to be alive and adherent to the tibia. The pedicle is indistinguishably fused with the capsule laterally and the free margins of the flap with the capsule elsewhere. The distal end of the flap which covers the internal tuberosity shows less necrosis than the proximal portion over the external tuberosity.

The amount of necrosis seems dependent upon the amount of pressure the external condyle in this case being longer than the internal caused more destruction.

The upper recessus of the joint is obliterated. The transplant under the patella is alive and adherent to both patella and femur. The condyles of the femur are reddish and covered by small irregular granulations.

Microscopic examination Transverse section through condyles of femur shows surface of external condyle polished smooth and bare. Bone dust in the crevices along the surface. Marked subcortical new bone formation. In the intercondylar groove there is a new fibrous surface covering with spongy walls and absorption of the superficial trabeculae. The internal condyle has a thin fibrous covering shows absorption of surface trabeculae fibrous marrow and no cortical new bone formation.

There was pressure over the lateral tuberosity causing extensive necrosis of the underlying lymph but little pressure over the internal tuberosity producing only a small area of necrosis.

A wedge shaped section of the flap was excised with the base over the anterior part of the tibia and the apex in region of the broken down portion over the middle of the tuberosity. The deeper portion next to the tibia is practically all alive but as the free



Fig. 1. I d l d flap 6 d s p e m t D b
N 3 Typ c l t l c t l f m d

surface and extremities are approached at how necrosis (Fig. 14). Bordering on the perforation it is completely broken down and thinned out (Fig. 15).

Fig. 2. I d l d flap 6 d s p e m t D b
N 3 Typ c l t l c t l f m d



Fig. 3. I d l d flap 6 d s p e m t D
N 3 Typ c l t l c t l f m d



Fig. 4. I d l d flap 6 d s p e m t D b
N 3 Typ c l t l c t l f m d

f m l l three lo es v th ch l afte cutt g
th r e p s t n d n l lunculat l flap of f a
int po d D s i g r m o d and dog k l l e l
the f u r t e n t h d a y S l i g h t i f e c t i o n f t h e
k i n

V r p v Ba of th flap n t a c t I n c s n
int a p s l e h l e l W h n j o i n t i s o p d t h e f l a p
i f n i l a d h e t t t h l u n e u l d e s n o t
s j a t e n l s a t i l a t I n i t m i d d l e p o t o n
l e t e t h e o n l y l e s i t s b r k e n d n p t e r i o l y
n a l m t a l l o f t s e x t e n t A n t e r l y i t i s l o o e l y
t t h e l t o t h e l u m r u s a l h l o f t h e r a d i u s
T h r t i u l a s s a c o f t h e i l l i s c o v e r e l b y a
v i r t e f i b r o u e x u d a t T h r e s s o m p r l i f r a t i o n
f t h e a p p l e b u t t h e m a g i n s

M i r o p i c a r i a l L o g i t u d i n l n d a n
s c t o f p t e r h a l f o f I n h e s a c r g o f
n e v f i b r s t i u e v t h l e u c y t i n f i l t r a t o n p e
c i a l l y l g t h e u f e U n d e r l y i n g n r r o
l g h t l y n b r o u M d e r t e n m b e f n l y
f r d t r b e c u l a e a l t h b n y s r f a c e

A l o n g t u l l i s t n t h o u g h t h e r a d i l d
h o t h r l c o r e d b y c a t l a g e e x c e p t h r e
t h d b e n c m o d f r o m t h e d e a n d v a r g i n I n
t h i s l i t t e r r e g i n t h e e s a f b u s c o c i g t h
n l o u s n r r o n t h e u n d e l y i n g c a n c l l o s j e s
S l i g h t n e c s f t h e c p e d t r a b e c u l a e a d i
p l a e s n e w l y f m g t r a b e c u l a e T h s u r f a
l i h s t i l l e r e d b y c a r t l g e h a t h n n
t u p t e l r m n t f l a p v e r t I t i t t a c h e d
a t n e d e b y g r a n u l a t i o n s i n v a d i g i t f o m t h e
c a p l e

I f c r i T v e r s e s t n t h g h p s t e r r
p o r t i n o f t h e c o n d y l T h e t i c u l r s f e s
c o e e d b y f l a p n i t s n t e x t t A t t h e s i d e s



Fig 24 Free flap 3-day experiment Dog No 50 Uncompressed portion showing cell proliferation about margins



Fig 5 Free flap 14 day experiment Dog No 44 Region of tibial spine along surface A new bone formation beneath B

the flap is thick adherent to the capsule and only partly degenerated. Over the middle portion it is very much thinner and almost entirely necrotic. In some places along the bony surface some of the deeper portion is alive. There is an outgrowth of fibrous tissue from the marrow spaces of the spongy bony surface which is invading and replacing the necrotic flap. In this region there is no evidence of cortical new bone formation.

14 day experiment Dog No 43 Knee. Tibio patellar tendon cut and sutured. Pedunculated flap between femur and tibia. Bandage left on until animal was killed on fourteenth day.

Necropsy. The tibia is slightly displaced medially on the femur. The line of incision is closed except for a small gap in the region of the tibio patellar tendon. All traces of the pedicle of the flap are gone. On opening the joint and reflecting the quadriceps tendon laterally it and the patella are adherent to the anterior surface of the femur completely obliterating the upper recessus. The granulation tissue stays with the reflected tendon leaving a bare granular denuded bone. On separating the femur from the tibia a joint cavity 1.5 cubic centimeters in diameter is formed in the region of either condyle where the flap was completely broken down leaving necrotic fibrous shreds. The flap is intact about the margins and along the intercondylar ridge where relieved of pressure. The surviving portion of the flap along the tibial ridge is irregularly adherent to the intercondylar groove. Condylar surfaces covered in patches by fibrous exudate and granulations between which is found denuded bone. The

flap has blended with the capsule about the margins of the upper end of the tibia. There appears to be no more necrosis of the flap distal than proximal to the pedicle.

Macroscopic examination. Transverse section through femoral condyles. The entire surface of the mesial condyle is bare and smooth with necrosis of the superficial bony trabeculae and marked new bone formation. The superficial marrow spaces are markedly fibrous. The intercondylar groove is deep and still contains the attachments of the crucial ligaments from which there is a fibrous outgrowth along the surface. The lateral condyle is somewhat depressed and covered by a thin layer of the flap which has undergone complete necrosis. The bony surface is irregular with a fibrous covering growing out from the superficial fibrous marrow and replacing the necrotic remnants of the flap. Considerable new bone formation along the surface. At the lateral margin a portion of the flap pedicle fill the upper and lateral recessus of the joint and is reflected over the articular surface in which region it becomes necrotic.

Tibia. Transverse section through the articular surface. Remnants of the flap can be traced across the entire section. Laterally its pedicle is seen to be alive and proliferating and is bowed upward by a small inflammatory area. Where the lateral portion of the joint is reached the flap rapidly thins out becomes necrotic and over the lateral half of the external tuberosity which was opposed by the prominent mesial portion of the lateral condyle entirely disappears. The mesial portion of the lateral tuberosity and lateral portion



Fig. 28. Intact free flap 120 day experiment. Dog No. 23. Fibro joint opened from in front showing arthritis with fibrous articular covering.

and on microscopic examination was found to be necrotic.

16 day experiment Dog No. 8. Knee. Extensive resection of joint. Pedunculated flap of fascia lata of the tibia and also under the patella. Bandage removed on the eleventh day. Wound clean. Dog died on the sixteenth day.

Necropsy. Incision in the capsule well healed. Flap beneath patella partly broken down. On opening through the line of the joint the flap is found to be alive about the periphery and in the intercondylar region forming a rim of tissue about and attached to the tuberosities of the tibia simulating semilunar cartilages. The flap is also attached to the capsule about the condyles of the femur. The intercondylar portion of the flap is loosely adherent both to the tibia and femur. In each condylar region it is entirely broken down leaving 2 perforations the lateral of which is the larger (Fig. 16). Mesially the bony surfaces of both tibia and femur come in contact and are somewhat polished from friction. On the lateral side they are covered by debris from the necrotic flap. The patella is covered by a thin layer of partially necrotic flap. The surface of the femur opposite the patella is covered by a fibrous ingrowth apparently from the sides (perhaps from the marrow spaces). The patella and quadriceps tendon are loosely adherent to the femur.

Microscopic examination. Femur. Transverse section of the femur beneath the patella. The surface is covered by a newly formed fibrous layer and by a portion of the patellar flap which is adherent to the surface about the middle. The bony surface is smooth and spongy with numerous newly formed trabeculae. There is slight fibrosis of the superficial marrow spaces.

Transverse section through the condyles of the femur. The condylar surface is smooth and formed by spongy bone which in places is covered by a layer consisting of fibrin in its outer portion fibroblasts and new connective tissue along the bony surface. The fibrous covering is growing out from the marrow spaces and absorbing the fibrous outer layer. In places where the bony surface is bare there is marked cortical new bone forma-

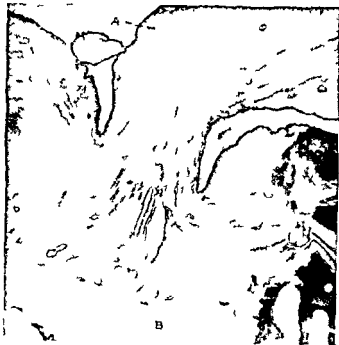


Fig. 29. Free flap 120 day experiment. Dog No. 23. Adhesion of the synovial covering arising from intercondylar groove.

tion. The fibrous marrow extends deeply into the underlying bone.

A transverse section through the patella shows articular cartilage all removed except about the mesial margin. The surface is formed by spongy bone. There is a thin bridge of flap over the articular surface which becomes thicker at either side. There is considerable necrosis of the flap overlying the articular surface. A thin layer of fibroblasts attach it to the patella.

The patella flap is thinned out and partly visible. The joint surface was between the flap covering the tibia and the femur. The articular surface is forming on the femur by sclerosis of the bare portions subject to pressure and fibrous overgrowth of the remaining portions. The fact that the flap was more extensively broken down in its lateral portion near the pedicle shows that pressure is responsible for the necrosis and that the distal portion of the flap does not get its nutrition through the pedicle.

4 day experiment Dog No. 8. Knee joint. Extensive bone resection. Patella left intact. Pedunculated flap of fascia and muscle interposed between femur and tibia. Bandage changed on fifth day. Mild skin infection which cleared up in a few days. Dog died on forty second day.

Necropsy. Hail joint. There is a posterior subluxation of the tibia. Remnants of the condyle of the femur are saddled over the anterior

j r m nt | t t l t b l c t n l b u l f r r l
 nt t th l t t l l r t d Ma k l
 f t l r l d l e n i n g o f
 th t l l g v e l t l l r r l u l r s u r f a c e
 f t h t u l h n t t h t l p a t l l i t l b u
 l t l t l l i g n t l t r t n g t h u p r
 t t j t O u t t g t h j n t
 j l t v i s f l b t n t h n h l
 j l t l e a n t t l r l u f l t h e t i b i o
 j t l l t l b l n l n n t T l f a l
 d l l t l n c t l g t h n t e f r e
 t t l n d r f l e t j r l t j o s t r
 t t t h p a t l l a t l t h e u p p e l i m i t
 t t l j c a t i t y I t p a t h e r l d t a r s l y
 j t h l t h e s e t n t h t b i p a t c h r t e n d o n
 l p r e d b e t c t h e p p s s u r f a c e s
 f t t n n a n d t i b l e t r i l t h r a
 d a v i t y s p a a t e d f r m t h j n t j e b y a
 t r u t t a t t a c h t t h p t o l i m i t f
 t h t l a s u f a c f t h i m r T h e t e r n a l
 l l f t h e f m u r s r o u g h a n b r e b u t n o t
 d n T l t e n a l c o n l y i s c e e d e d f r e s h
 i d h g a l l a t i o n T l n l f t h f l a p a r e
 l l r e v e l a n d f e d t h t l e c a p s l e o n e i t h e

The flap is preserved in four fifths of its extent and at either side because the femoral condyle are extensively retracted and displaced forward and there was no pressure on the intact portion. The flap apparently played no part in the joint formation.

Mc p eto ti i A tra se e ti n
 thr ough the ant r e su fa e f the f h o v s a thin
 fbr u o ing o e the po g v b ne h ch is i
 outg with fr m the surf e and has no connection
 t! the flap (Fig 1)

A t ans e ect n thr ugl the a ucl t ig
 pa t of th f al dyl h s th surf e of
 th e term l ndyl f m d by b r som hat
 ghened nd spongy b ne th prt lcs of l l
 t abecula nd bul f the utg o ugg anul t ons
 in the cot cal n o p At the te nal
 margi a mall t sis The r t f the a tic
 ultr urf e i co eed by fib ou lver vch i
 thick o r the inte ndyl r g ov d th n over
 th m lc lyl Ther i me t al le o is
 and sup ric al fl r us marr w Th u fac f the
 fibrous cov g is n de w p ts th ke p t ons
 of granul t g necrot t su n ts l ner i o t ons
 of j n r t bous t e runn g p lcl to the
 b ne

A transverse section through the middle of the upper end of the *tabac* leaf, the eighth bearing completely covered by the fascia lata flap which readily adheres to the bony surface by cellular fibrin strands. The vascular formation places (Fig. 8). The lymphatic vessels are not shown in the formation. The tissue of the trabeculae is highly glaucous.

b ption The e is an xt n ive exo t sis at
 ith r de It flap l s som e d nce of
 s in m ll half but e va culanz d
 an r l hly c ll hr l n s tony att l cent n
 ts f urf llich v lntly lly outs d the
 jnt a l r att l d t l s r r u d g tissues
 the n de c t jnt l r g

This is the most pronounced instance of preservation of flap but the reasons for it are obvious. The bone was extensively resected and the tibia backwardly subluxated so that the flap was compressed between the bony ends in only a small portion of its extent in which region breaking down occurred.

56 days exp t it D g \ 4 Ilbo T cept
t n l n cut At t ul r a tilage r m d ith a
ch sel Pe lunculate l fascia nd muscle flap ut ed
o r th r d san l u D es t gr mo ed on the
t l th day W und clean At the end of 56
days the limb little use l lking Range of
m tion bo t 60 le,ree Animal sacrificed

The triceps tendon completely healed.
 No evidence of infection. Capsule entirely re-
 lined. The joint surfaces adhere at the top
 of the lesion and in two places along the te-
 condylar groove. The end of the head of the
 humerus is smooth and bony. The central portion
 of the humeral surface regularly destroyed and
 replaced by a layer of granulation tissue which has
 eaten away the bony cortex except in the mal-
 leolar border. The humeral head is flattened.
 The bony articular surface
 of the humerus has all been eaten away and covered by
 a layer of fibrous granulation tissue except for a
 small area along the distal margin.
 The humerus is in contact with the humeral condyle of

th ough the articu lar fa ce of the *intra* h th
fib ou s vering of the t r a ticu lar face It
cl ly adhe nt to the b n and is sl ghtly re rot c
l ng th j nt surf ce A bony exostosis is pr se t
at eit he de

f condyl of humer h s a very i eg lar s r
 fac c el by a laver of tbous ti ue rv g
 n thi k s th ough ut t e t e e tent The
 ells and fbe s f this co ga e de e an l un
 pa all to the b n surface It efi ct d
 the ma gins f the condyles on to tler d s The
 u de ly gl n v face s spony and devoid of
 cort l layer The m o spaces tend up to
 the tb u cove ing r d e filled by al efb us
 vacuol t d tissue which is n t t tly conn t d
 th the c e ng v f n ly f r mel c r t c l
 t bec lae ar n The e is a sha p b y f r
 j c t t eith e rmarg h ch leg gl c a
 ab opt n l about h ch t e s l s nev

bone formation The free surface of the fibrous covering is in places necrotic A cut surface of an adhesion is seen near the external condyle

Ulna Transverse section through post part of ulnar articular surface shows the surface covered in its entire extent by a layer of fibrous tissue which runs parallel to the bony surface It is thin along the crest and increases in thickness toward the sides where there are bony exostoses The bony cortex is dense but somewhat worm eaten along the surface beneath the fibrous covering The joint surface extends beyond the exostosis at either side where there is a villous arthritis and over the mesial exostosis a tendency to differentiation of the lining into fibrocartilage There is no endothelial lining the surface being mostly irregular and necrotic No section was made through the dense bare bony region

The fibrous ulnar covering appears to have grown in from the sides and out from the ends of the bone It is thinnest over the ulnar crest where subject to the greatest pressure In places it consists of dense flattened fibrous tissue in one place showing a tendency to form fibrocartilage The covering of the humeral articular surface resembles in some respects a persistent flap but there is nothing about its histological structure which identifies it definitely as such

76 day experiment Dog No 1 Elbow Lateral incision Triceps tendon cut and sutured after removal of the articular cartilage with a chisel Pedunculated flap used Wound healed rapidly though infected bandage left off on twelfth day Joint not used in walking Animal died on seventh day Limb held in flexion Range of motion about 15 degrees

Necropsy Fibrous ankylosis Articular surfaces joined by fibrous adhesions Cavity practically obliterated except for a few small pockets anteriorly When separated there is a thick fibrous covering over the articular surface of each bone Head of the radius (ulnar side) bare over a small area In region of the three small pockets anteriorly the bony surface is practically bare

Microscopic examination Humerus Transverse section through condyles Posterior portion shows thick fibrous covering with areas of degeneration along the surface Small cavities with necrotic walls representing small joint pockets About the intercondylar groove is a larger cavity which opens onto the surface The character of the fibrous covering varies according to the thickness and whether it is a continuation of an adhesion In the latter case its free margin is a cut surface and it is fairly rich in nuclei and blood vessels The cells and vessels are arranged in columns radiating from the bony surface and are more numerous in

the deeper portions next to the bone There is a somewhat irregular frail newly formed bony cortex The marrow spaces extend irregularly out to the surface and are filled with bone marrow little fibrous marrow being present This is in marked contrast to the earlier specimens showing fibrous marrow

Normally as the joint surface becomes reformed the cortical fibrous marrow which forms early recedes giving way to normal marrow

Slow ossification of the fibrous bridge is proceeding from the bony surface by endochondral bone formation This gives the junction of the bone and covering the appearance of an epiphyseal line It seems probable that a bony ankylosis would eventually have been established

9 day experiment Dog No 35 Knee Tibio patellar tendon cut Articular cartilage and some underlying bone removed with chisel Pedunculated flap of fascia lata interposed between femur and tibia Dressings removed on seventh day Wound clean On thirtieth day flexion complete extension to 145 degrees On ninety second day flexion complete extension to 145 degrees Limb not used in walking Joint flail

Necropsy Patella movable but is attached by loose fibrous adhesions between which are small cavities Its surfaces and the opposing surface of the femur are partly bare partly covered by adhesions Upper recessus of the joint obliterated Tibiopatellar tendon lengthened and represented by a thin fibrous band On opening the joint there are cavities a larger mesial and a smaller lateral one separated by an anteroposterior partition extending from the crest of the tibia to the lateral side of the intercondylar groove The limb is held in flexion and the posterior portion of the condyles border on these joint cavities the anterior inferior portion being extracapsular and covered by fibrous tissue The bony surfaces of both cavities are irregularly grooved dense and almost entirely covered by fibrous tissue The mesial cavity contains fibrous tags and fibrinous flocculi resembling villous arthritis

These joint cavities are comparatively small and are formed with the limb in flexion despite this there is a wide range of motion

Microscopic examination Femur Transverse section through prominent portions of condyles of femur shows an irregular bony surface covered largely by a thin fibrous outgrowth which is necrotic along the surface There is a small surface of bare dense bone at the outer margin of the external condyle and about the middle of the internal condyle

T b o Through p i n t s f c o n t a c t J o i n t c a v i t y
e t e n d s l a t e l y b e y o n d t h e b o n y l i m i t i n t o a
r e c e s s w i t h a v i l l o u s n e c r o t i c l i n g T h e f l a p i s
b r o k e n d o w n v e t h l a t e a l b o n y m a g n a n l b a e
d e n s e b o n e f r m s t h e j o i n t s f a c e O v e r t h e d e
p r e s e d a t n l t u b e t r m n a t s o f t h e f l a p
r e a d e n t t l u n l h n f o n j b y u r f c
t h e t n l y i e g l r v i l l o u s e c r o t i c s u f a c e
l i n g t l j o i n t a v i t y l t r a l l y M e s a l l y t h e r e
s a s t h j o i n t s u r f a c e a n d t h e c u t s u r f a c e o f
a b r o a d b a n l w h i c h c o s t o t h e f e m r t o f o r m a
p a i t i n T h m e s i a l j o i n t c i t e t a n d s f m
t h e l a t r a l s f a e o f t h e t i b i a l s p i n e t o t l i n n e r
l i m i t f t l e b o v u f c M e t a l t u b e t y
r k e l l d e p r e s s e d T h e t b l p n e n t h e m i d d l e
i s b a e d n a n d p o l i s h e d T h e e i s a n i e g l r
t h i c k r e m a t o f f l a p c o v n t h n t i r e t u b e r o s i t y
a n d a t t a c h e d t o t h e i n t e r n a l c a p s u l e f u t h e j o i n t
O n i t s u p p e r s d e t h e f l a p f r m s t h e l i n i n g o f
t h e j o i n t c a v i t y w h i c h i s v i l l o u s a n d n e c r o t i c l i n g t h e
b o r d e r A l o n g t h e l e r s u r f a c e t h e f l a p i s a d
l e r e n t t o t h e l a t e l p t o n o f t h e i n t e r n l t u b r o s
i t y a t t h e b a s e o f t h e t i b i a l s p i n e b u t e p a r a t e l
f r o m t h e l s u r f a c e o f t h e t u b e r o s i t y b y a
f l a t t d e r i v i t y t h e l l f w h h f r m d b y
t h e f l a p b a n d a t b o u s o u t g o t h f m t h e
t i b i a l s i t e b l l w h i c h i s c o n t i n u o u s i n
t e r a l l y i t h t h e m e l e e s u s o f t h e j o i n t b e
n a t h t h e f l a p T h i s r e c e s s u s h a s a s y n v a l l i n g
b u t t h e j o i n t c a v i t y o v e r t h e t u b e r o s i t y h e r
u b j u t t r e u e h n e c r o t i c l i n g T h e
c i t l l n v t h e d e p r e s s e d e g s s p r s
a n l l l c u n r a b s r f t i o n

Two main joints are formed between the femoral surfaces above and the flap below but the flap is broken down over the tibial spine and outer margin of the external tuberosity where dense bone forms the joint surface Mesially where the flap is thick a narrow cavity is formed between it and the fibrous covering of the surface of the tuberosity This cavity communicates with the mesial joint recessus This is not the true joint cavity but a sort of bursal sac between the flap and tuberosity where there was little pressure It was by this method that Sumita and Payer thought that the new joint cavity was formed

15 day x p i t D o g N o 74 A c c Ex
t e n s e s c t i o n P a t e l l a n o t d i s t u r b e d P e d u n c
l a t e d f l a p u s e d W o u n d i n f e c t e d D r e s s i n g s l e f t
o f f o n t h i f t h d a y W o n d h e a l e d i n w e e k s
R a n g e o f m o t n 35 d e g r e e s

N e c o p s J t c p u l e m h e d l y t h c k n e d
E x o s t o s s b o u t t h b o n y m a r g i n s T h e r i s a
c a v i t y b e n a t h t h e p a t l l a c o n t i n u o u s i t h a l a g e
t i b i o f e m o r a l j o i n t c a v i t y T h e t b a l s u f a c e
s o m e w a t c u p s h p e d M t f t h e j o i n t u f c

of both bones is formed by eburnated polished bone It is impossible to identify any remnants of flap The irregular depressed areas between the region of eburnated bone are covered by fibrous tissue The margins of the dense portions are covered by a thin fibrous layer which is apparently growing in from the sides in an endeavor to cover all raw bony surfaces There are large tags and irregular projections from the capsule as in a villous arthritis There is extensive ossification of the thickened capsule at its points of attachment to the femur and tibia

Microscopic examination Femur Transverse section through anterior surface of femur just above patella Complete obliteration of the upper recessus The bony surface is smooth and spongy with a few newly formed trabeculae and some evidence of superficial absorption It is covered by a layer of fibrous tissue which is dense and arranged parallel to the bony surface in its deeper portions but loose and irregular superficially

Femur Transverse section through middle of condyles within joint cavity The capsule is thickened on either side and exostoses extend outward into it There is a villous synovial lining to capsule on either side The articular surface is fairly regular It is interrupted by six small grooves The articular surface consists of bare dense polished bone or most of the surface of the broad intercondylar groove and the mesial half of the internal condyle The lateral half of the mesial condyle is nearly all of the internal condyle are covered by a dense fibrous tissue which the bony surface is irregular and grooved In places the fibrous covering is differentiated into a fibrocartilage the ossification proceeds into it from the bony surface resembling articular cartilage The grooves are being filled the bone by ossification proceeding from the sides There is a little tendency toward a fibrous overgrowth of the bare bony surfaces about their margins Joint lined formed largely by dense fibrous tissue poor in nuclei Where it covers a bony articular surface frequently it is necrotic and shows a tendency to metaplasia into fibrocartilage

Despite the extreme thickening and ossification of the capsule which were augmented by the infection there was joint cavity formation The lining is largely fibrous and villous There are still areas with a bare bony surface and little evidence of active replacement by fibrous tissue about their margins A cavity exists beneath the patella which is due no doubt to the fact that its articular cartilage was not removed

146 day experiment D o g N o 66 A c c j o i t
E x t e n s i v e r e s e c t i o n P e d u n c l a t e d f a s c i
l a t a i n t e r p o s e d b e t w e e n f e m r a n d t i b i a — a l s o

under the patella Bandage left off on seventh day One hundred and forty sixth day limb used slightly in walking Extension to 150 degrees flexion complete Joint somewhat flail Animal killed Slight backward dislocation of the tibia Patella movable

Necropsy The excised joint has good mobility with some upward and downward movement of the patella The joint is multilocular There are four cavities two anteriorly beneath the patella and upper part of the tibioapatellar tendon and two between either condyle and the opposing tuberosities The partition between the latter is in the region of the crucial ligaments It is impossible to identify remnants of the flap as such The surface of the *patella* is markedly eroded in its upper portion eburnated and polished infero-internally The articular surfaces of the *femur* and *tibia* are irregular and covered by a fibrous layer except at points of contact of the condyles and tuberosities where the bony surfaces are either bare or covered by a thin outgrowth or outgrowth of fibrous tissue The small bare area over the lateral tuberosity of the tibia is eburnated and polished There is a depression in the opposing portion of the external femoral condyle

Microscopic examination Femur Transverse section anteriorly through lower part of patellar articular surface of femur Articular surface over lateral condyle and intercondylar groove formed by smooth spongy bone with evidence of absorption of the ends of the trabeculae and a little new bone for formation The lateral limit of the mesial condyle is prominent sclerotic and bare Just mesial to this there is a deep groove at the edge of which is a bony exostosis The groove is covered by a thin fibrous layer which partly fills out the defect and forms an irregular necrotic joint surface A mesial joint recessus is lined by endothelium The intercondylar groove is filled with a thick layer of fibrous tissue which forms the joint lining mesially and presents a cut surface of an adhesion laterally This layer is continued over the external condyle becoming very thin at its lateral margin There is a joint cavity with a superficially necrotic lining over the entire surface of the lateral condyle

Tibia Transverse section through tibial articular surface shows a marked exostosis at either edge especially laterally Covering the joint surface and the exostosis is an irregular thick fibrous layer along the free surface of which there are cavities both mesially and laterally separated by broad fibrous bands At either edge and extending out over the exostoses there is a slit like cavity between the flap and the bony surface which does not communicate with the joint cavity The lining of a part of the cavity resembles endothelium the rest is necrotic and irregular It contains some small fibrinous masses (Fig 10) The bony surface of the joint is very irregular over the lateral portion of either tuberosity being quite dense elsewhere only moderately sclerosed The ends of the border

ing trabeculae show lacunar absorption The fibers of the covering run irregularly parallel to the surface except where the adhesions radiate out from the surface

Patella Transverse section The articular cartilage is all removed The mesial surface is of bare dense bone The base of the flap at the edge which has broken down is represented by small villous tags The lateral surface is covered by a thin fibrous layer which has a tendency to differentiation into endothelium along the surface There is a thick overhanging ledge of fibrous tissue extending inward from the side to middle of the patella It has a villous necrotic surface and may represent the lateral remnant of flap but is separated from the bone by a joint space

The cavity between the surviving portion of the flap and the tibial margin resembles to some extent a bursa and may correspond to what Sumita took for bursa like formation within the flap It no doubt arose from the ply of the flap over the bony margin produced by the constant motion in the joint but forms no part of the true joint cavity

161 day experiment Dog No 3 Elbow Articular cartilage removed except small amount on side of external condyle Superficial bony surface partly removed Pedunculated fascial flap interposed Dressings left off on ninth day Wound clean Mobility remained free throughout and at the date of sacrifice was almost normal in extent The limb was used to some extent

Necropsy Upon opening the capsule a joint cavity free from adhesions along the bony surface is found (Fig 9) The flap has disappeared except a portion of the pedicle which was adherent to the outer portion of the ulnar articular surface and is white and very dense There is a villous arthritis of the synovial membrane on the mesial side of the joint The articular surface of the humerus is dense smooth shiny and free from cartilage except for small islands about the periphery which have reformed In these areas the bony surface is slightly depressed as if previously eroded by overgrowing tissue A similar condition is found on the ulnar articular surface There is a defect on the mesial side of the ulnar ridge due to erosion which is filled out with fibrous tissue A fibrous disc representing the base of the flap is firmly adherent to the lateral side of the ulna and posterior portion of the radial head The surface of the radial head is partly covered by apparent islands of cartilage The rest is formed by dense polished bone

Microscopic examination A section transversely through middle of femoral condyles has a smooth free articular surface throughout At either side the attached capsule shows villous arthritis A bony exostosis projects from the lateral margin The

entire surface of the internal condyle is of smooth dense bar bone (Fig 21). The costal trabeculae are increased in number and are arranged at right angle to the surface. A small amount of superficial necrosis is in the lacunae of the trabeculae along the border being empty. The marrow spaces are greatly diminished in size and some of them extend out onto the bony surface. Most of them are filled superficially with a necrotic debris some of which takes a bluish taint indicative of calcification. There is fibrous marrow in the space. The intercondylar groove and extending anteriorly into the lateral condyle the bony surface thickened by a thick layer of imperfectly rimmed articular cartilage which thus underlies the cells arranged in irregular columns. The trabeculae substance lies along the junction and calcified along the bony surface (Fig 22). The active areas of fibrous growth about the margins of the lateral condyle. The external condyle is covered by a layer of thin articular which is continuous with the articular in case of thickening of the articular margin reached until it supports the normal thickness at the edge here it is the thin plate of material at the side. In place of the degenerated bone. It is a layer of bone which has a normal appearance. The layer of the portion of the cartilage is calcified immediately and has cells radiating in columns from the bony surface as in a normal joint (Fig 23). The intercondylar groove appears normal. At the junction of the cartilaginous covering of the intercondylar groove and the external condyle there is just beneath the surface a fibrous round mass which is undergoing ossification. This is probably the remnant of a groove that is being filled out. A wedge of fibrous tissue resembling the pedicle of the flap extends inward from the capsule into the area of the internal condyle. Sections of the covering of the articular surface show latently a villous surface. It is difficult to say whether or not the epiphyseal remnant of flap.

This is the best reconstruction of the entire series of experiments. Mobility was free and the joint cavity almost normal in extent. The articular surface was formed by dense polished bone over the internal condyle but by a layer of articular cartilage in various stages of development over most of the remaining portions. In some places the restoration was so complete that it could hardly be distinguished from normal articular cartilage all of which it was thought was removed at operation. If any cartilage was left it was in the shape of small island which would have had to possess an unusual degree

of proliferation to give rise to this extensive covering. The flap had all disappeared except a small portion of the pedicle.

RESUME OF CHANGES FOLLOWING IN PEDUNCULATED FLAP OPERATIONS

Summarizing it will be seen that in the well constructed and fitting joint the flap undergoes necrosis at the points where it is subjected to any degree of pressure between the ends of the bones. The flap breaks down first over the central portion at the points of greatest prominence of the condyles and tuberosities. In case of the knee joint two holes appear in the flap over either tuberosity of the tibia by the fifth to the sixth day. In Fig 16 Dog 82 16 day experiment the greater necrosis is over the external tuberosity which is nearest the pedicle of the flap. This shows that little nutrition reached the flap through the pedicle and that pressure was the cause of the necrosis. The perforations are separated by a bridge running anteriorly along the intercondylar groove which is little subjected to pressure. As time goes on more and more of the flap becomes necrotic until finally nothing is left of it except perhaps a rim about the margins of the joint or an irregular strip lying in a groove where it has not been subjected to pressure. The peripheral portion of the flap becomes attached to the surrounding synovia or capsule and survives. In the earlier experiments on the knee joint going from the periphery toward the central portions of the condyles the flap thins out becomes necrotic and disappears leaving a margin about the periphery closely resembling the semilunar cartilages. This is also seen in portions of the elbow joint as illustrated by the 9 day experiment No 5 Fig 13 but persisting bridges extending across the joint along the intercondylar groove of the humerus were not observed as was the case occasionally with the knee. Where resection was extensive or dislocation occurred thereby diminishing or completely removing the pressure upon the flap greater areas survived. In this event the somewhat altered remnant of flap usually became attached to the end of the bone over which it had been sutured.

tibia in case of the knee and humerus in case of the elbow and the joint cavity formed between its free surface and the opposing bone or the flap came to lie outside the joint cavity which was much diminished in size (see No 78 42 day experiment) In no instance was the flap seen to split and become attached to the ends of the two bones thus forming a joint cavity within its substance as suggested by Murphy and Payr and described by Sumner

The formation of small cavities was observed between a portion of the surviving flap and the margin of the bone to which it became adherent but lying outside the newly formed joint (Fig 19) These correspond closely to what Sumner described as cavities formed within the flap

The changes in the ends of the bones over which the flap broke down are identical with those in the no flap operations The areas subjected to pressure undergo sclerosis forming a hard smooth polished joint surface while those subjected to less pressure acquire a fibrous covering The tendency of the fibrous covering to change into articular cartilage increases with age These points are especially well illustrated by experiment No 3 161 days ligs 21-23

Flaps placed beneath the patella behaved in the same way breaking down in their central portions but remaining alive about the periphery of the patella and beyond the zone of pressure where they became adherent to the surrounding capsule Cavity formation beneath the patella occurred oftener when its articular cartilage was left intact and no flap was inserted

The size of the joint cavity and the amount of villous arthritis in the older experiments were about the same as they were in the no flap series

It is difficult to understand how anyone who has worked much with pedunculated flaps can believe that any appreciable amount of nutrition is furnished by the circulation through the pedicle All of the evidence in these experiments spoke for the reestablishment of circulation in the surviving portions through adhesions to the parts with which they came in contact

FREE FLAP EXPERIMENTS

The difficulty of securing a pedunculated flap of the proper size and thickness in certain instances and locations led to the use of the free flap Murphy stated that he used this method on the human in two of his earlier cases with poor results but little experimental work was done for determining its role in the process of new joint formation

Kirschner in his extensive review of fascia transplantation cites a number of instances of its clinical use in the mobilization of ankylosed joints but presents no evidence as to how it acts simply stating that it is as good as any other material for the purpose

Allison and Brooks who made careful studies of experiments in which the flap was placed in the joint space between the patella and femur found that it rapidly broke down and was removed from the joint The same changes were noted in the ends of the bones as where pedunculated flaps were used but again no experiments were performed upon the joint between the tibia and femur

Nineteen experiments were studied 10 of which were on the elbow and 9 on the knee Six experiments were mildly infected all of which healed promptly

day experiment Dog No 41 Knee Tibio patellar tendon cut Resection made with a saw and chisel Free flap of fascia lata between femur and tibia Dog died on second day Wound clean

Necropsy No evidence of infection Tibio patellar tendon had separated The capsule had begun to unite on both sides The base of the flap (which had been cut free) was partly united to the capsule The entire surface of the tibia is covered by the free flap which toward the joint side is covered by a serofibrinousanguineous exudate The articular surface of the patella and tibia is covered by the same kind of exudate

Microscopic examination Femur Anteroposterior section through mesial condyle Bony surface fairly regular Articular cartilage and underlying cortical bone removed leaving a cancellous bony surface Numerous fragments of sawdust in open marrow spaces Irregular thin covering of hemorrhagic exudate Little change in underlying marrow in a few places it shows blood extravasation in others beginning connective tissue proliferation Section of the flap shows beginning necrosis in the center leucocytic infiltration about the periphery

Flap Periphery of flap alive Slight fibrous proliferation Central portion slightly compressed Leucocytic infiltration and evidences of necrosis

5 day experiment Dog No 39 Elb E
tensive resection Free fascia lata flap used
Death on sixth day Skin wound clean but o
removal of the soft parts an abscess was found
anteriorly in the muscles communicating with the joint

Necropsy Joint capsule partly open Large
abscess antero-medially in the flexor muscle connected with the joint Capsule and surrounding muscle inflamed All of transplanted broken down except a band posteriorly extending across the joint covering the posterior part of the tibial condyle intercondylar groove and patellar tibial condyle Bony surfaces smooth and show little evidence of erosion
If microscopic study shows the flap very necrotic especially in the deeper portions where practically

There was mesial displacement of the tibia and fibula and extensive erosion of the lateral condyle by the prominent and pointed upper end of the fibula Flap necrosis is well under way where compressed but shows marginal proliferation where free from pressure

6 day experiment Dog No 39 Elb E
tensive resection Free fascia lata flap used
Death on sixth day Skin wound clean but o
removal of the soft parts an abscess was found
anteriorly in the muscles communicating with the joint

Necropsy Joint capsule partly open Large
abscess antero-medially in the flexor muscle connected with the joint Capsule and surrounding muscle inflamed All of transplanted broken down except a band posteriorly extending across the joint covering the posterior part of the tibial condyle intercondylar groove and patellar tibial condyle Bony surfaces smooth and show little evidence of erosion
If microscopic study shows the flap very necrotic especially in the deeper portions where practically

There was mesial displacement of the tibia and fibula and extensive erosion of the lateral condyle by the prominent and pointed upper end of the fibula Flap necrosis is well under way where compressed but shows marginal proliferation where free from pressure

6 day experiment Dog No 39 Elb E
tensive resection Free fascia lata flap used
Death on sixth day Skin wound clean but o
removal of the soft parts an abscess was found
anteriorly in the muscles communicating with the joint

all the nuclei have disappeared Superficial portions at one end show extensive leucocytic infiltration and granulations At other end in the region of dense fibrous tissue slight leucocytic infiltration and occasional connective tissue nuclei are seen

The results of the infection are shown in the rapid breaking down and removal of the flap and in the bare bony articular surfaces

14 day experiment Dog No 44 Elb E
Tibiopatellar tendon cut Ends of tibia and femur embedded with a soft Free flap of fascia lata inserted Animal killed on fortieth day Wound clean

Vaccop Incision in joint capsule entirely closed Tibiopatellar tendon apparently healed Patella adherent to the femur by granulations Upper recessus obliterated Joint cavity present in condylar region The flap is necrotic over area in contact with the condyles Central portion completely destroyed all contact of bony surfaces Peripheral portions of the flap are shaped like semilunar cartilages and are partly alive The flap over the tibial crest is necrotic in its central portion where there is pressure Condylar surfaces are bare and grooved into position only the mesial one more so from erosions by tibial surface The margins intercondylar groove and anterior surface in contact with the patella are covered by granulations which are eroding the dense bony surface The surface of the patella is also covered by granulations

Microscopic examination Tibia Transverse section Nothing present that can definitely den

Infection has produced bare bony surfaces and complete disappearance of the flap

14 day experiment Dog No 44 Elb E
Tibiopatellar tendon cut Ends of tibia and femur embedded with a soft Free flap of fascia lata inserted Animal killed on fortieth day Wound clean

Vaccop Incision in joint capsule entirely closed Tibiopatellar tendon apparently healed Patella adherent to the femur by granulations Upper recessus obliterated Joint cavity present in condylar region The flap is necrotic over area in contact with the condyles Central portion completely destroyed all contact of bony surfaces Peripheral portions of the flap are shaped like semilunar cartilages and are partly alive The flap over the tibial crest is necrotic in its central portion where there is pressure Condylar surfaces are bare and grooved into position only the mesial one more so from erosions by tibial surface The margins intercondylar groove and anterior surface in contact with the patella are covered by granulations which are eroding the dense bony surface The surface of the patella is also covered by granulations

Microscopic examination Tibia Transverse section Nothing present that can definitely den

tified as a flap except about margins. Marked deepening of the condylar groove at either side of tibial crest. The epiphysis is so extensively removed laterally that only a thin bridge forms the external tuberosity. Below this there is extensive periosteal new bone formation which extends downward along the mesial side of the shaft for a distance of 1 cubic centimeter. At the upper limit of the shaft just beneath the joint surface is a large island of cartilage resembling a center of ossification. The articular surface in the region of the tuberosities is covered by a layer of granulation tissue which thins out and disappears over the intercondylar ridge. Mesially it blends with the capsule and laterally thins out over the projecting ledge of bone forming the external condyle where it disappears. This covering consists of fibroblasts with large vascular spaces in its deeper portion and an extremely irregular necrotic surface. The vessels run from the bone toward the periphery. Underlying bony surface is irregular. In region of tibial crest where dense bone was left the surface is bare, sclerotic, smooth and slightly grooved. Marked new bone formation in underlying trabeculae to a depth of 1 cubic centimeter (Fig. 25). Slight new bone formation along surface of the depression in mesial tuberosity. Sclerosis more marked at the side where it came in contact with underlying island of cartilage. Moderate sclerosis of the cortex of the shallow groove on the external tuberosity. Marked sclerosis of the ledge of bone forming the lateral part of external tuberosity. The surface of the lateral tuberosity which is devoid of covering is polished with bony debris in the superficial marrow spaces. Periosteal new bone formation along the lateral surface of the shaft and ledge is by endochondral ossification; that in the articular end is by fibrous ossification.

Marked sclerosis along the bare cortex has occurred at points of contact and weight bearing less so in the depressed areas. Compensatory hypertrophy has resulted to support the weakened ledge forming the external tuberosity.

Flap. Transverse section through condyles. Condylar surfaces are bare and eroded; bone dust filling in the crevices along the surface. Marked cortical new bone formation. Over the groove where there was no pressure a necrotic exudate is seen; bony cells spongy and marrow spaces slightly fibrous.

1 day experiment Dog No. 68 Knee. Extensive resection. Free fascia lata flap used between tibia and femur. Fascia and muscle flap from vastus internus beneath patella. Dog died on fifteenth day. Wound clean.

Veopsy. Posterior subluxation of tibia. Patella movable on femur. New capsule completely formed. Condyles of femur rest against the anterior margin of the tibia down to the tibial

tuberosity pushing forward the tibioapatellar tendon. The quadriceps tendon, patella and capsule on either side are adherent to the inferior and anterior articular surface of the femur. The flap covering the upper end of the tibia is intact and adherent to the tibia except anteriorly where it was pressed upon by the condyles and has disappeared. The posterior capsule of the joint is stretched forward over the upper end of the tibia by the dislocations and is loosely adherent to the flap which is very thin. It fuses about the margins with the capsule. In its necrotic portion it is free and easily dissected from the tibia. The posterior part of the condyles at points of contact show extensive pressure necrosis. The surface about the margins of this area which are within the cavity are covered by granulations. Joint cavity very small. Flap beneath patella broken down over its lower portion but forms a thin layer over the upper portion and about the margins.

Microscopic examination Tibia. Transverse section through region not subjected to pressure shows articular surface removed almost to the epiphyseal line. There is a central elevation corresponding to the tibial spine. Bony surface is spongy with necrosis of some of the ends of the trabeculae. The superficial marrow is fibrous. There is practically no cortical new bone formation. The surface of the mesial tuberosity is covered by a thin layer of granulations which run irregularly parallel to the surface and have grown out from the marrow spaces. Lateral surface is covered by thinned out remnant of flap which shows moderate necrosis. The flap is adherent to the underlying bone by newly formed fibrous elements. Necrosis in the flap is more marked along the joint side than along the bony surface. There is some revascularization and proliferation of the surviving fibrous elements (Fig. 6).

Tibia. Transverse section through anterior part where the flap is adherent to the capsule at the side of the tibioapatellar tendon. Flap folded and considerably degenerated. There are recesses and small cavities in it with necrotic walls. Some revascularization and proliferation of the surviving connective tissue cell is seen.

Where the flap was subjected to pressure it underwent necrosis as over the tibia and the patella. Where there is no pressure and no flap a fibrous covering has formed as on the anterior surface of the femoral condyles.

17 day experiment Dog No. 30 Elbow. Re-section with chisel. Free fascia lata flap. Wound badly infected. Death on seventeenth day.

Necropsy. Joint wide open laterally. Capsule thickened and inflamed. Articular surfaces are bare. Some granulation tissue from capsule filling marginal recesses of the joint.

Microscopic examination Humerus. Transverse section through condyles. Bony surface bare in most

of its tent All of the tissues stain poorly. There is a fusular overgrowth for short lists cealing the inner surface of the internal condyle in which are fragments of cortical bone which are detached but not mediotraposition. The rest of the surface of the medial condyle is bare and faint. The margins are open. The epiphysis has no cortical new bony formation and the exposed trabeculae have been polished by friction and the fragments fill the intertrabecular spaces along the surface. The superficial slightly fibrinous and surrounds the surface of the joint. The cells stain evenly and the tissue appears somewhat cellular in large condyles and in the tie. The condylar growth is slightly necrotic. The layers rich avascular joint flap. Along the bony surface from the lateral and anterior parallel trabeculae. No cartilage and a little irregular fibrous matter. The medial joint fibrillated indurated and covered by cartilage. The iliofemoral ligament there comes to the iliofemoral ligament and the fibrous matter. The surface of the iliofemoral ligament shows absorption of the bony trabeculae and a fibrous condensation with the iliofemoral ligament. Bone absorption is a general surface and at the distal end of the femoral surface and at the distal end of the femoral surface. The iliofemoral ligament and the bony surface stain poorly in the iliofemoral section.

Despite the infection there is a tendency to formation of a fibrous covering sclerosis of the portion of the cortex subject to pressure and little evidence of infection invading the deeper portions of the bone ends.

19 d x p m i c t Dog No 83 K1 L
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t bia n l also beneath patella Ba dage emoved
on t elftl day Wo n l pp r ntly clea Death
on n nteenth day

op e n g abo v the base i f the flap P tella quite
 ad h e n t m a r g i n o f the caps le Space be
 t w e e n p a t e l l a a n d f m u r filled w i t h f b r n Pat illa
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 t h e s m a l l o p e n i n g e l e r e d t o a b o e The a n t e i o r
 s u r f a c e o f t h e f e i s c o v e r e d b y a t i n t l y e r o f
 f i b r o u s t i s s u Th p a t i l l a h a s a o u g h b a e c e n t r a l
 t r a l r e a s r o u n d e d b y f i b o u s t i s s u e

by a thin layer of fibrous tissue underlying
pongy slightly porphyritic bone. The lateral

border margin covered by fibrin instead of fibrous tissue. This is apparently the point of contact with the patella.

Femur Transverse section through condyles at points of pressure. Somewhat irregular articular surface. Marked thickening of the capsule and exostosis at sides of the joint. The mesial condylar surface is formed by the pyg bone which is bare and some lateral process in its middle portion with absorption of the superficial trabeculae slight depression of the surface and fibrous overgrowth on either side of the condyle. Intercondylar groove filled by regular yellow vascular fibrous tissue with hemorrhagic surface. External condylar surface irregular with definite evidence of inflammation of the articular bone. The superficial body trabeculae are small and the marrow spaces filled with leucocytes and granulations. There is marked absorption of the subcortical bone by the surrounding granulations. The marrow spaces of the underlying hyaline bone are not filled with new formed fibrous tissue in the recesses of inflection with cortical necrosis.

Tibia Tra-ec-tion through anterior part of tibia including emnant of flap Tibial's face narrow in this region with marked fibrous thickening in and extoses at either side Flap xtends to the entire section but thins out and is necrotic leaving a bony surface in regions of tibial crest and a small area at outer margin of late at tube ostiv Tibia is moderately infected and slightly inflamed in thicker portions about margins and completely regenerated in its thinned portions The necrosis of the cortical layer of bone with granulation tissue formation in marrow spaces producing extensive lacunar absorption The bare bone of the tibial crest is entirely necrotic and is being absorbed and sepa-ated by granulation tissue in its marrow spaces In this region the bone is some bone formation even in the presence of inflammation and extensive absorption

The presence of infection has resulted in necrosis of the flap and articular surfaces of the femur and tibia. Evidently such cortical necrosis leads to grooving and formation of adhesions. This experiment shows how an infection may extensively involve a joint and break through the capsule without involving the skin or giving external signs of its presence.

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Joint flail C ps le entirely l al d
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Tib pat llar tendons and ligament at ther side
adherent to the ant r o su fac of the c dyles
d a ticular su face of fem r Patell slightly
n able ab v On strpp g d wn the t b o

patellar tendon a cavity is opened into in which the condyles and tibia are in contact. The flap is broken down in this region but intact about the margins where it forms a rim about the joint and is adherent to the newly formed capsule about the sides and tibioapatellar tendon in front. The external margin of the tibia fits into the intercondylar groove and the tibial crest which was left at operation has been worn away by friction against the internal condyle. The surfaces of both are polished and are becoming dense. The other articular surfaces where there is no contact are rough and spongy. The posterior portion of the tibial articular surface where not in contact with the femur is covered by the adherent capsule.

Microscopic examination Femur Anterior surface below patella. The surface is covered by a thick fibrous layer which has undergone extensive necrosis. It is adherent to the spongy bone by a slight layer of fibroblasts which extends out from the marrow spaces. There is some absorption of the tips of the cortical trabeculae. Slight new bone formation at margins. Similar changes are seen in the tibioarticular surface.

This joint shows the usual extensive degenerative changes and destruction of the interposed flap.

26 day experiment Dog No 81 Knee Extensive resection Free fascia lata flap used Patella not disturbed Bandage removed on twelfth day Wound clean Dog sacrificed on twenty sixth day

Necropsy Limited motion Limb held in flexion. The anterior part of the joint is obliterated. The tibioapatellar tendon and newly formed antero lateral part of the capsule are firmly adherent to the anterior surfaces of the epiphysis and condyles of the femur. A rather small joint cavity is found between the tibia and posterior portion of the condyles. It is difficult to trace the flap. It is apparently preserved about the margins and blended with the capsule. A band extends from the posterior part of the joint to the intercondylar groove. Bony surface of tibia bare and rough in central portion a thin dense fibrous covering about the margins. Condyles of femur posteriorly rough and bare.

Microscopic examination Femur Transverse section through anterior surface above the joint. The surface is covered by a layer of fibrous tissue and the joint recessus is obliterated except for a small cavity at the mesial side which has a thick lateral wall and is partly filled with fibrous masses. The cortical bone is spongy and shows no new bone formation. The epiphysis is not completely ossified and shows a rim of cartilage beneath the periosteum. There is a small amount of cortical fibrous marrow.

Femur Transverse section through condyles in weight bearing region. Considerable of the epiphyseal surface has been removed extending nearly to

the epiphyseal line in the region of the intercondylar groove. The articular surface is quite irregular. The bony surface over the external condyle is porous and irregular and is covered by an incomplete fibrous and organizing fibrous layer which seems to have grown out from the underlying fibrous marrow. In places the layer is very thin or absent but no corresponding cortical sclerosis is seen (apparently no pressure). The lateral surface of the internal condyle is composed of dense bare polished bone which is partly a remnant of the normal cortex and partly newly formed in the marrow spaces. The rest of the condyle has an irregular spongy bony surface with slight new bone formation and a thick fibrous covering. The articular surface of the femur has an irregular necrotic lining where formed by fibrous layer. Where formed of bare bone there is little tendency to sclerosis.

Tibia Transverse section through anterior portion. Epiphysis not entirely ossified. It was removed down to the epiphyseal line on the sides leaving a bony elevation in the region of the tibial spine. At the outer side there is a thick fibrous covering which probably represents remnants of the flap. Between this and the central bony elevation the epiphyseal line is covered by a thin layer of fibrous tissue running parallel to the surface necrotic in its superficial portion. The most prominent part of the tibial spine has a dense bare bony surface with underlying fibrous marrow. The mesial tuberosity has a fibrous covering in its outer portion and a surface of unossified epiphyseal cartilage at its mesial border.

There are no flap remnants except possibly about the external tuberosity of the tibia. Irregular incomplete fibrous covering of the articular surfaces. Where joint surface is formed by bare bone there is little sclerosis. This can be attributed to the fact that there was extensive resection and little motion in the joint.

4 day experiment Dog No 22 Elbow joint Articular cartilage and some bony cortex removed with a chisel. Free fascial flap interposed. On fifth day cast removed. Slight skin infection at lower angle. On twelfth day wound healed. On forty second day range of motion 75 degrees. Limb little used in walking.

Necropsy Thickening of the joint capsule. A joint cavity is found anteriorly and posteriorly in the region of the olecranon. In the middle a broad band of adhesions extends across it uniting the humerus to the ulna. On separation the condylar surface is eroded leaving a deep groove in which the adhesions were attached. The rest of the articular surface of the humerus is partly bare and shiny. About the margins the dense cortical layer is eaten away and replaced by granulations. On the ulna a similar condition is found. The head of the radius

is covered by a thick fibrous layer. There are no traces of any thing definitely identifiable as flap.

Microscopic examination of the joint. Transverse section through condyle. A narrow recess of dense bony cortical bone at the inner margin of the medial condyle is normal to which the cortex is spongy and extends apically into a deep groove at the outer margin of which passes over into another strip of dense cortical bone at the outer margin of the intercondylar groove. The intercondylar groove is deepened and its walls are formed by spongy bone with a fibrous covering. The medial third of the lateral condylar surface is formed by dense bare bone. The lateral surface of the condyle has a fibrous layer covering a spongy cortex. A cartilaginous osteophyte is seen at the lateral limit of the joint. Where the fibrous covering of the lateral surface of the lateral condyle meets the dense bony surface the tissue is lacunar absorptive in character. The dense bony surface is covered by a fibrous layer. The groove of the condyle has a smooth surface in the upper part of the groove has a columnar arrangement resembling in places newly formed endothelium. No bone formation about the entire margin of the joint.

44 days perimortem Dog V 5 Elbow. Extensive resection. Free fasciata flap used. Joint became badly infected but healed promptly. Range of motion good. Joint not used.

Necropsy. Thick joint capsule. A cavity is found posteriorly and anteriorly except in front by a fibrous band. Bony surfaces covered laterally by a fibrous layer which is continuous with the capsule. Portions of the condyles along the groove covered by dense bare bone in front of which is considerable white necrotic tissue which may be degenerated flap.

Microscopic examination: Humerus. Transverse section through condyles. Lateral recessus of the joint obliterated. Joint cavity along most of the articular surfaces. In region of the external margin of lateral condyle there is a small area of bare dense bony surface. From the middle portion of the lateral condyle a broad fibrous band comes off. The surface of a portion of the intercondylar groove is formed by dense bare polished bone which is being eaten away by the granulation tissue from the other side. There is a joint cavity over the mesial part of the lateral condyle which is grooved and has a fibrous covering with a necrotic surface. Joint cavity is obliterated over the mesial half of the internal condyle which has a thick fibrous covering.

Ulna transverse section. Articular surface is covered by a thick fibrous layer with a necrotic fibrous surface which gives off broad adhesions. Along the crest is a small area of bare bony surface which is being eaten away by granulations from the sides. Marked new bone formation along the surface beneath the fibrous covering and extensive periosteal new bone about the entire circumference of the ulna.

In this experiment there was marked thickening of the capsule and grooving of the bony surfaces. Fibrous adhesions and bands across the joint space reduced it to a number of small cavities.

58 days experiment Dog No 13 Elbow. Articular cartilage and part of the cortical bone removed with a chisel. Fascia flap of fascia used. Bandage removed on twelfth day. Wound clean. Dog died in 58 days. Range of motion almost complete. Some backward and outward dislocation of the forearm and grating in the joint on manipulation.

Necropsy. The capsule is thin except over the coronoid fossa. Complete cavity present. Entire surface covered by a layer of red granulation tissue except over the areas one posteriorly and one medially each cubic centimeter by cubic centimeter. No other each condylar surface and a few very small regular patches these areas having a smooth dense bare surface and irregular worn edges. The entire articular surface of the radius and ulna is covered by red granulation tissue except a narrow strip along the mesial border of the ulnar ridge and a few scattered very small irregular patches. These areas all have a bare roughened surface and irregular worn edges.

Microscopic examination: Humerus. Transverse section through the bare sclerotic area on internal condyle and fibrous covering of external condyle. Mesial the sclerotic area the bony surface is irregularly depressed and covered by fibrous granulations which have sequestered a thin strip of cortical dead bone and have eaten away nearly all of it. The sclerotic portion is smooth and the trabeculae along the surface contain no bone cells. The marrow spaces are small and slightly fibrous. The external condyle and intercondylar groove are depressed and have an irregular spongy bony surface with a thick fibrous covering continuous with the underlying fibrous marrow. Toward the outer limit of the internal condyle there is a small elevation of sclerotic bone with some necrosis superficially and with an irregular thin fibrous covering. The fibrous covering is necrotic along its surface except over the intercondylar groove where the superficial tissue is partly live. There is no here any evidence of a definite synovial lining.

Ulna. Transverse section. The dense bony edge is smooth and shows absence of cells in most of the superficial lacunae. The underlying marrow spaces are diminished by the formation of new bony lamellae.

Lateral to this the bony surface is irregular and spongy with a thick fibrous covering the outer layer of which is hyaline and necrotic the deeper portion being richly cellular. No necrotic bone is seen along the surface but scanty new bony trabeculae form an imperfect cortical rim. This rim increases in thickness toward the periphery where there is a large fibrocartilaginous callus in which an osteophyte is forming. Mesially the sclerotic surface extends to the periphery of the joint surface where there is a large marginal exostosis. The marrow beneath the spongy surface is fibrous for a shallow depth only.

There is nothing about the character of the fibrous covering to indicate whether it is a remnant of the flap or a fibrous outgrowth. The line of junction between the fibrous covering and the bare cortical ridge is irregular due to lacunar absorption of the bone by ingrowing granulations. Apparently the dense bony joint surface is gradually being absorbed and the fibrous covering is growing over the entire surface. A portion of the capsule with synovia attached at the side shows considerable hyperplasia with a degenerated lining without any endothelial covering.

26 day experiment Dog No 29 Elbow Quite extensive bone resection. Free flap of fascia lata sutured about end of humerus. Wound clean. Motion rapidly re-established. At end of 62 days flexion to 30 degrees and extension to 10 degrees.

Necropsy After removing the muscle attachments the limited motion seemed due principally to the thickened short anterior capsule. Upon cutting through the capsule a cavity is found extending over the entire bony surfaces except for a few fibrous bands the peripheral portions of the condyles and intercondylar space posteriorly. Olecranon and coronoid fossae are largely obliterated by fibrous tissue. The articular surface of the humerus is mostly smooth dense and shiny about the margins and in the region of the internal condyle there is extensive absorption of the cortex with grooves filled with fibrous and granulation tissue. Over the posterior half of the external condyle is a thin layer of granulation tissue. All definite traces of the flap are gone. The nodules on the capsule and a few small villi may represent remnants of it. About one half of the ulnar articular surface is covered by dense smooth shiny bone polished by the friction. About the margins posteriorly most of the surface is eaten away and replaced by a thick layer of granulation tissue. The capsule is adherent to the sides of the radial head. The joint surface of the radius is partly smooth partly covered by fibrous tissue growing either from the capsule or remnant of the flap.

Microscopic examination Humerus Transverse section through interior portion. The deep notch in the internal condyle is covered by a loose layer of maturing fibrous tissue. Irregular spongy bone forms its walls. The superficial marrow is slightly fibrous. The bare sclerotic surface extends from the middle of the internal condyle across the intercondylar groove to the middle of the external condyle. It is smooth and the cells of the superficial lacunae are largely necrotic. The underlying marrow spaces are largely obliterated by new bony lamellae the remaining portions being filled with fibrous marrow. The outer surface of the external condyle except a small elevation at the periphery has a depressed bony surface covered by an overgrowing fibrous layer the cells and scanty blood vessels of which run parallel to the surface. The bony surface beneath this is spongy and shows lacunar absorption. At the junction of the fibrous covering with the elevated sclerotic bony surface there is lacunar absorption showing the tendency to removal and fibrous overgrowth of the bare sclerotic bone.

This shows well the early extensive sclerosis of the cortex forming the articular surface with subsequent replacement by a fibrous overgrowth.

Ulna Transverse section through middle of the articular surface shows a large exostosis on the lateral edge of the joint at the seat of the capsular attachment. There is a very large sessile mass of newly formed bone on the mesial edge and peripheral new bone formation on the posterior surface of the ulna decreasing in amount as the posterior surface is approached. The mesial recessus of the joint is filled with fibrous tissue and callus. The ridge of the articular surface consists of bare smooth dense bone except for a groove in its middle portion where the floor is spongy and shows some lacunar absorption. The groove is filled with fibrous tissue necrotic along its surface. The lateral surface of the ridge is covered by a thin fibrous layer richly cellular along the periphery and mature in its deeper portion with nuclei arranged parallel to the bony surface. As the lateral margin of the joint is approached this deeper layer increases in thickness and represents definitely remnant of the flap. Its superficial portion shows marked hypertrophy and degeneration along the lateral surface of the joint.

There is a remnant of the flap along the lateral articular surface of and recessus about the ulna where it was not subject to pressure. Marked bony hypertrophy about sides of ulna.

63 day experiment Dog No 28 Elbow Re-section with chisel. Free fascia lata flap used. Joint became badly infected. Healed in 18 days.

On the 1 day abt 45 dg es f m tion
Limb held in flexion and little use

Ulnar process joint to elbow use
Limb in position to elbow anteriorly
align the elbow and the radial head
tissue fills the joint space and the
ulnar surface protruding from the
Wrist distal ulnar bone gliding freely
mate the thumb to the fingers
joint pulsed the ulnar bone
thumb motion joint not rigid bone

Ulnar process at the elbow
section through the joint in flexion
the joint surface is covered and
ulnar surface is covered by the
tissue except the triangular articular
fossa of the ulnar head and the
trabeculae that the construction
of the ulnar head is to the
cancellous bone. The articular
lining the ulnar head is
the joint surface is covered by the
cell and pocket of the
of the ulnar head mature and
of the ulnar head mature and
along the ulnar head is
her not the ulnar head is
ulnar head is mature and
a is the ulnar head is
from infection

Ulnar head section The ulnar surface in
the region of the joint has a covering similar
to that of the ulnar head. Fibrous tags project from
onto the joint surface where they are a
degenerate. There is a surface of a broad
adhesion of the ulnar surface which tend
to the ulnar head of the humerus

This infected joint showed a very small
cavity many adhesions a thick fibrous cover
ing of the entire surfaces and lacunar absorp
tion in the underlying bone ends No special
cortical sclerosis

Ulnar process at the elbow
tension of the joint Fr flap of fascia
lata sutured over the end of the humerus
Banding the ulnar head
learn the ulnar head
tension of the elbow
flexion of the elbow
Limb held in flexion
Ulnar process at the elbow

Ulnar process at the elbow
loose fibrous adhesions between the
about the ulnar head a number of
cavity No trace of the flap of the
identical. Of the ulnar head is
dense fibrous tissue. If the ulnar head is
adherent to the ulnar head by the

tissue The mobility of the joint is due to the
ligamentous bands and small cavities

Ulnar process at the elbow
section There is a fibrous covering over practically
the entire articular surface. It is thick over the
mesial condyle here the joint cavity is obliterated
by adhesions to the articular surface of the ulna
There is no trace of a joint cavity lining. As the
ulnar condylar groove is approached the fibrous
covering becomes thin and a fibrous band pro
jects its surface forming the floor of a cavity. Over
the ulnar condyle the covering is moderately
thick and has a joint cavity along its entire surface.
In the place of the periphery is a cross section of a
cavity within the ulna closing a small amount
of debris. The covering of the ulnar condyle
has been transformed into a simulating a normal
articular cartilage in that the underlying bone is
irregular and an imperfect cortical layer has re
formed the narrow fibrous for a short
depth. The cells of the superficial layers are
arranged in irregular columns radiating from the
diaphysis and many of them contain two or
more nuclei. Along the surface the nuclei are few
in number and in places are arranged in irregu
lar columns (Fig 27). Small irregular bony outgrowths
on the ulnar surface are seen. To reach the
lateral surface of the ulnar condyle the
definite ulnar head is seen which may have come
from emphysema during operation. In the
ulnar condylar groove the covering is thin partly
ossified and has little resemblance to joint lining.
The surface of the fibrous band is bridging the joint
and a heavily degenerated thin plates of cells
have grown a three nuclei resembling the
line of cartilage

Ulnar process at the elbow
ulnar head is the same general characteristics
as that of the ulnar head of the humerus
On the ulnar head the ulnar head is a similar cavity

Radial longitudinal section Joint surface
obliterated about the ulnar head but present over the
central portion of the end. Resemblance to normal
articular cartilage is striking though over the
humerus. The covering is continuous with the
near the bone head continuous with the
fibrous covering. There are cells in the tissue
between the joint cavity many of them having
two or three nuclei

Fibrous covering unusually thick but can
not be definitely identified as coming from the
surviving portions of the flap. It is thick
over all three bony surfaces. The covering
of the bony surfaces bordering the cavity
resembles strikingly normal articular car
tilage particularly in the arrangement of the
cells. The reason for the complete fibrous
covering of the ends of the bones at this

rather early date is to be attributed largely to the extensive resection which was performed

19 day experiment Dog No 72 Small animal Knee Considerable bone removed Free flap of fascia lata interposed between femur and tibia Wound clean On the fortieth day flexion to 80 degrees and extension complete Small amount of lateral mobility Tibia displaced slightly backward One hundred and twenty ninth day dog killed with ether Range of motion about 70 degrees Patella fixed Limb was little used in walking

Necropsy Small cavity beneath the patella which is displaced mesially and adherent to the internal condyle A rim of new bone has formed about its margin A joint cavity 3 cubic centimeters by 1 cubic centimeters is found between tibia and femur No adhesions have formed in the region of the crucial ligaments No joint fluid The anterior surface of the femur above the joint is covered by a fibrous layer The joint surface of the femur is shifted somewhat posteriorly The articular surface is very uneven and covered by a thick layer of fibrous tissue except in three areas along the posterior margin where dense cortical islands of polished bone are seen The tibial surface is similar having three corresponding islands At the outer margin of the joint on the femur are three wartlike exostoses with fibrous or fibrocartilaginous coverings Remnants of the flap are apparently attached to the back of the tibioapatellar tendon although all definite traces of the flap have disappeared

Microscopic examination Femur Transverse section through anterior surface of femur in the region of the patella shows the entire surface covered by a thick mature layer of fibrous tissue The underlying bone is porous and moderately irregular Over the mesial side which was opposed by the patella there is an articular surface with a slightly villous lining of poorly cellular fibrous tissue No evidence of an endothelial lining

Femur Transverse section through condyles of femur in region of joint cavity Joint cavity extends across the entire bony surface There are joint recesses showing slight villous arthritis and lined by imperfect endothelium on either side at the edges The lateral portion of the external condyle is deeply eroded forming a groove with a spongy bony wall filled with a mature fibrous tissue which has a joint lining mesially but at the side presents a cut surface of an adhesion The mesial half of the external condyle is covered by dense bare polished bone The intercondylar groove is deepened and filled with fibrous tissue which has a shaggy articular surface Its walls are of spongy bone but ossification is proceeding into the fibrous tissue filling the groove The surface of the internal condyle is composed of dense bare bone except near the lateral margin where there is a small groove

filled with fibrous tissue giving off an adhesion and about the mesial margin where there is a fibrous covering resembling slightly newly formed articular cartilage

Fair joint formation between tibia and femur but marked irregularity of its surfaces No traces of flap over the femur Separate cavity beneath patella Considerable dense bony articular surface present

129 day experiment Dog No 23 Elbow Re section with chisel Free flap of fascia used Upper part of skin wound infected Healing rapid On the forty seventh day 60 degrees of motion Limb held in flexion and not used in walking At end of 129 days 40 degrees of motion Limb little used

Necropsy Joint cavity almost entirely obliterated Motion possible on account of the loose fibrous adhesions separated by many small cavities Olecranon and coronoid fossæ filled with fibrous tissue and new bone Articular surfaces mostly covered by a thick shaggy fibrous layer (Fig 8) Bony surfaces extensively grooved There are a few bare areas of dense bone Radius very slightly movable on ulna Some lipping of joint margins

Microscopic examination Humerus Transverse section through condyles Surface covered by fibrous tissue except over small part of lateral portion of internal condyle and mesial portion of external condyles Bony exostoses at the seat of the capsular attachment to the sides of the condyles Capsule thickened and endothelial lining of the recessus about sides is present The mesial three fifths of the internal condyle has a covering which is becoming differentiated into a structure resembling an articular cartilage The cells of this covering radiate in columns irregularly from the surface they are more numerous and in places take a hæmatoxylin stain along the bony surface Superficially the columnar arrangement is less distinct the nuclei are fewer the matrix paler Many of the cells have double nuclei like those of hyaline cartilage The underlying bone has an irregular dense cortical layer Some of the superficial marrow spaces under this contain ossifying fibrous tissue The surface of the outer third of the mesial condyle is bare dense smooth bone At either side ossification is occurring in the marrow spaces The intercondylar groove is narrow markedly depressed and filled with a sparsely cellular fibrous tissue which gives off a broad adhesion on its free surface The floor of the groove has a spongy bony wall which shows marked leucinar absorption Ossification is occurring from the sides of the groove particularly about the inlet The surface of the fibrous covering of the groove and adhesion where devoid of pressure resemble a synovial lining (Fig 20) The mesial third of the lateral condyle has a dense smooth bare bony surface the most

the flap disappears dense shiny bony articular surfaces usually form Grooving from friction of the opposing irregular surface is common Extensive resection makes less pressure and consequently less necrosis

Infection causes rapid disappearance of the flap as seen in a number of early suppurating joints which were discarded Mild infection may be followed by a fairly satisfactory functioning joint as in Experiment 23 19 days Fig 28 but thickening of the capsule villous arthritis grooving and a fibrous covering for the articular surfaces result

SUMMARY

The changes which follow resection of the articular surfaces and construction of a new joint by the three methods employed are in general as follows

1 *In the no flap operations* A joint cavity forms which is diminished in size because of more or less obliteration of the recesses about the sides from thickening and ossification of the capsule and adhesions of the synovia Excised portions of the capsule and synovia are rapidly but atypically restored Villous synovitis is frequently present even in the oldest experiments Articular surfaces form on the ends of the bones as follows over the prominent portions which contact with and are pressed upon by the opposing bone a dense bare bony surface forms which as a result of motion soon becomes smooth and shiny over the sides grooves and depressed portions which are subjected to little or no pressure a fibrous covering forms by outgrowth from the open cancellous spaces along the surface With increasing age the fibrous covering usually tends to spread over the entire bony surface gradually absorbing and replacing the dense bare bony areas This change is a slow one and in some of the oldest and best functioning joints large bony surfaces were present the process seeming to be at a standstill

The range of motion varied from 50 degrees to almost normal and generally was greater in the elbow than in the knee joint

2 *In the pedunculated flap operations* The flap early undergoes pressure necrosis and disappears except about the margins and

along the grooves where it is not pressed upon As motion is re established more of the remaining portions are destroyed until eventually little of the flap is left Only a small part of the base of the flap receives its nutrition through the pedicle Any other portions which survive become attached to the ends of the bones and participate in the formation of a fibrous articular covering for the region

The changes in the articular surfaces of the ends of the bones are practically identical with those occurring in the no flap operations In the regions subjected to pressure a dense polished bony articular surface forms while in those subjected to little or no pressure a fibrous covering forms partly by outgrowth from the underlying bony surface and partly from surviving remnants of the flap

The size and appearance of the re formed joint cavity and the range of motion were about the same as in the no flap experiments

3 *In the free flap operations* The flaps break down and disappear in the same manner and to about the same extent as in the pedunculated flap operations The changes in the articular surfaces of the bones and the character and mobility of the reconstructed joint are the same as in the other two sets of experiments

Infection prolonged immobilization displacement and too extensive and imperfect resection unfavorably influenced all three groups of experiments to about the same degree Hence it matters little in experiments on the normal knee and elbow joints of dogs whether arthroplasty is performed by the no flap pedunculated flap or free flap method The flaps here used very largely break down and the newly formed joint is about the same both structurally and functionally following the three types of operations

It would be unwise to draw too definite conclusions as to the similarity of changes and functional results obtained from operations on these and on human joints ankylosed as a result of disease While there are many points of resemblance as the bare bony articular surfaces and the relations of the flap when one is interposed there are also many

differences. The muscle tendons and remaining portions of the capsule are normal in the dog. In the human as a result of disease and prolonged disuse the muscles become atrophied, the tendons adherent and the capsule thickened so that it is impossible to obtain early active motion as in the dog. On the other hand this disadvantage is considerably offset by the intelligent co-operation of the patient permitting of the early use of massage and active and passive motion. However it seems probable that in the operation for mobilization of ankylosed joints the result will be the same whether or not a flap is interposed. Certainly the most important steps are the construction of a well fitting new joint, the excision of any thickened or obstructing fibrous tissues and proper after treatment for the maintenance of mobility.

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PRIMARY HYDATID CYSTS OF THE UTERUS

B AUGUSTO TURENNE M EVIDE U L Y
P f f Cl 10b I I f M d

OBSEVATIONS on hydatid cysts of the uterus are so rare that the present case deserves mention.

November 5 1915 Seno a M ta V of R—Uruguay age 4 hite do for 10 months t d my ser ce in the Maternity Cl c Sh m t ated t 2 The mens s had always be n b dant and r gular and there n r had been menorrhoea H pr gn ces eight n num b r h d ll been n mal v th normal labors at t rm Her first troubl b g n bout two y a s ago and as ch r ct r d by m norrhagia h h in th ent months h d b en v ry copious

W th the except n of a slt hly ncrea d s t ctn ss of the sec nd aortic tone there is no p r c ptble organic h t les on U nary an l y s g s p petic g rav ty 005 acid reaction ur a 7 68 p cent chlorides 5 75 per nt albumin as p esent and there v ere a fe l ucocytes no casts The last menstruat on beg n October 27 last n unt l No ember 1 19

Exam t on ent ring th clin c show d the following Umbilic l cumference 87 centim t s parietal tension dimm hed several old skin fissures there is no comple nta y circulat n no tympanism no fluctu ation The hypogastrium s occupi d by a med an tumefaction slghtly mob l the

laterally and v rtic lly The vulva w th old c c trices shows n itler San er s spots nor Jacquemier s s gn The e are myrtiform atrophied caruncles The p neum shows an old cicatr d lacer tion of th first degree The vag na s norm l in amplitude there are anterior and posterior colpocle and cystocle The fundus is free except anter o ly where the tumefaction noted in the hypogastrium s felt The ut ne neck irrc ular and cyl ndrcal n form is no mal in direction and size v th cica t zed old sc s its secretion is normal both ori fices are clos d The body of the uterus is ante erted n normal pos t on situated vertic lly Hegar s and MacDonald s s g s are absent The axial he ght is 3 centimete s s anterior f ce sho s a somewhat res tant prom nence surrounded by clearly elastic tissue no fluctuat on

Hysterom try occr oned copious haemorrhage nd gave 16 centimeters The adne a ere not pl pated Th p amet um and pelvic peritoneum sho ed no alter tions

The cl arness of tl phys l findngs and the histo y of the patient called for the diagnos s of oedem t us uterine myoma situated in the ante or face Sh as operated upon November 9 19 5 Dr Curbelo L osa assis g and Nurse Chava ria ad m istering th anasthet c On cubic centimeter of morphine g en befo operation and ether

anaesthesia during operation. With the patient in the Trendelenburg position a median infra umbilical incision 15 centimeters long was made. On opening the abdomen the uterus showed every appearance of gravidity being smooth and congested the left ovary showed a hypertrophied corpus luteum. A hemispherical resistant prominence was seen on the anterior face of the uterus.

As manual exteriorization was difficult Doyen's helicoidal tractor was used and on perforation a stream of transparent fluid escaped apparently amniotic fluid of the first period of pregnancy. At this moment a doubt arose in my mind. We had not verified the last menstruation the aspect of the uterus was disconcerting, the corpus luteum was exceptionally voluminous the flow of fluid was not inhibited even by a catgut suture and copious hemorrhage persisted. We were convinced of a diagnostic error and thought it dangerous to leave an ovum opened and so decided on a median hysterotomy. At the first stroke of the bistoury the situation was cleared and a white translucent membrane showed through the breach. The cyst appeared to be single and the situation and dimensions of the cavity did not allow other treatment than hysterectomy. This was therefore done following the American subtotal method which was easy and rapid the left ovary and its hypertrophied corpus luteum also being extracted.

Definite haemostasis of the uterine pedicle was difficult due to the constant intrusion of intestinal loop which adequate use of compresses did not control. An acute dilatation of the stomach occurred which reached as far as the hypogastrium and which we were obliged to treat first directly and then through the abdominal wall. Sutures were taken in three places with a sandbag on the epigastrium. The patient continued well until the 23rd when an abundant diarrhoea suddenly appeared. This yielded to bismuth and lactic ferment but reappeared with less intensity on the 3th accompanied by pains in the iliac fossa and hypogastrium. The sutures were drawn on the 7th. The patient got up on the 30th without incident until the evening when suddenly and for the first time there was some fever (37.5 C) on the following day the temperature fell and the patient



Fig. 1. Specimen removed from author's case.

continued getting up. On December 5, fourteen days after operation an issue of fluid was noted through the vulva which continued during the night the hypogastric pain which had persisted for a few days disappeared.

An examination of the patient in dorsal decubitus on December 4 gave no clue to the origin of the escaping fluid. I resuming the existence of a ureteral fistula a methylene blue test was instituted. The urine showed strong coloration but the vaginal fluid was scarcely tinted. Clinical analysis of this fluid showed urea 1.8 per cent chlorides 4.095 per cent albumin about 15 per cent no glucose no evidence of echinococci a few pus globules leucocytes uric acid crystals many bacteria. December 6 absolute rest vesical sonde a demeure urotropin. As the loss of urine continued on December 10 Dr Delger assistant urologist made a cystoscopic examination which showed the bladder normal right ureteral papilla normal. On the left the orifice was pale and retracted and its ejaculation irregular. Diagnosis lateral incomplete ureteral fistula. A ureteral catheter was introduced which was well tolerated. From this day all vaginal loss ceased. Drainage by the catheter is perfect although the quantity of urine is less than in spontaneous micturition. The wound was

left in place until December 3. Urotropin was continued with instillations of protargol. By December 8 the patient was considered completely recovered.

Decription of specimen. The recently extrauterine cyst measured spherical form about 11 to 12 centimeter in diameter. An incision of millimeter open into rounded cavity with methind lining wall 8 to 9 centimeter in diameter on the interior to the right and left 1 centimeter on the transverse. The interior wall 1 to 2 millimeter thick while the posterior which separates it from the uterine cavity 1.5 centimeters. The cavity is located in the interior face of the uterus. The uterine mucosa thickened (1 to 4 millimeter) and in general the wall of the organ are hypertrophied. There are no signs of either perimetritis or parametritis, the extracted line (left) is healthy increased in volume and how a hypertrophied corpus luteum. The extracted membrane shows all the micro and macroscopic characteristics of hydatid cyst.

A I find in the beginning cause of hydatid cyst of the uterine tissue are very rare. A great many of the published cases refer to cyst of the cellular tissue or from the pelvic peritoneum opened spontaneously or punctured through the neck of the uterine cavity when not as in some old cases simple hydatidiform moles confounded by their macroscopic aspect with hydatidiform mole.

In Dr Salva Mercade the bibliography of which is very complete there are only found 14 cases collected from more than 100 years. Of these only 8 refer to primary uterine cyst.

In our country and in the Argentine Republic in which hydatid cysts are so frequent that in the case of every cystic tumor we ought always think of hydatid disease. I have only found one case and on inquiring I find that the distinguished Argentine surgeons Drs. Herrera Vegas and Cranwell have recently stated that they have knowledge of no other published case.

The cause of primary cyst of the uterus of which I have been able to read are 10 in number of which I append the usual

CASE 1. Wilton L. necet Lo 1 1841. Multipara 34 years. Uterine hemorrhage accompanied by apuliv p n S y that hydatid disease was thought for in the p t i t h o c l a l s s of trans p r n t f l i l D a t h b y h a m o h a g e Autopsy showed a group oficles adherent to the fundus and r p d g to a loc u n n f r i t e m t u e

CASE 2. Galy H. int Tr Obst Soc Lond 50. Impur ra 34 years. Slow solution 8 to 10 years. Spontaneous expulsion of vesicles. Necrohemorrhagic intrauterine injection of perchloride of iron 3. Intrauterine palpation showed the presence of hydatid the patient got up cured 3 weeks later.

CASE 3. Brn d S. acer 17 hr f G b rish u C y k 89. Nullipara 34 years. Lmaced Abdominal pains, ectal and vesiculation sm s exp l on f e s u l s R c o v y

CASE 4. Frnd A. chle toc log 188. Vesical in the posterior f f t h u r u s t r a c t e d b y p o t i o r c o l p o t m y (Scholer Malade des t m m Fr t r c 886)

CASE 5. I n a n d S e h y n N l l p r 4 years. Co t r a p t i o n v a l t n e m u s a b d o m n a l p a i n B i l t r i c o t o m y e x t r c t i o n R e c o v e r y

CASE 6. Altorn n L n t L d 89. Pr m p a 34 years. Solution of vesicles abdominal tumor l p a t i y p l u c u l a t e d h y d t i d c y s t o f t h e n e a l l (f u n d) R e c o v e r y

CASE 7. Br g 10 l l n d Torino 89. Women of 44 years. Spontaneous painful expulsion of vesicles. T r c u r t t d n l a m p u t a t i o n o f c r R e c o v e r y

CASE 8. H r r r A g d Cr ell Lo quis tes l l t i c o s e n l R p b A g e n t o Nullipara 9 years. Abdominal pains omit 6 months. Amenorrhea d arrhoea b d g e n e r l s t a t e U t e r u m l h d l a t d a n d o b l i t r t d c e r x e r y t n C e c o t o m y p u n c t u r a n d d r a i n a g D e d t d v l i t r

CASE 9. Kouzmin Ky g 903. III p of 21 years. Uterine tumor l p t o m y T u m o r f t h e p o s t e r o v a l l n d u t f u d S u p r g n a l l y s t e c t o m y T h t u m d g s l i b r o m a h o e d h y l a t l e o n t n t

CASE 10. A C I a C n l g 110 p 60

CASE 11. Autl C M o p 23 years. Al l m e n l g d p U t l r g d p l a t i o n p a i n f u l c r m l l m f O n e m a k i n g h y s t e r o m e t r y n l d l t u n t l H e g a r r g l a r g e q u a n t i t y o f f l u i d p e d h i c h n t i c d h y d a t i d v e s i c l e s U t e r u s m c h d u d i o l u m e d u r i n g f o l l o w i n g d v R e c y

There is no reason to suppose that in the pathogenesis of these cysts there is any other mechanism than in the case of such cysts in other organs. The monthly sanguinary flow may explain the relative rareness of implantation in the uterine tissue. (Salva Mercade)

and the direction of this drainage facilitates its submucous implantation (Cranwell and Herrera Vegas). But no matter how it happens the relative rareness of uterine implantation is evident since Vegas and Cranwell in 970 observations found only one case and in the hundreds of cysts observed in Uruguay in the last fifteen years there is not a single observation of a uterine cyst while pelvic implantation is far from being rare.

This rarity is increased if we take into account primary cysts that is to say those cases in which autopsy or clinical observation demonstrates the integrity of the rest of the organism. Our case enters into this category since minute clinical examination has not discovered any other cyst. But I do not deny that this argument is open to question because we know we can never be sure that there is no other microscopic parenchymatous involvement (hepatic pulmonary etc.).

This observation is all the more worthy of being taken into account since multiplication of such cysts is common even in the absence of operative contamination. Personally I saw a short time ago a patient on whom I had operated in 1910 for two cysts of the pelvic cellular tissue and one hepatic apparently single at that time and who shows three pelvic cysts and multiple hepatic as well as being three months pregnant.

Any attempt at a clinical description is unnecessary. Generally except in cases of vesicular expulsion a diagnosis is not made

The clinical signs uterine tumor hemorrhage amplitude of the cavity conduce to error. Sometimes when there is a fluctuating uterine tumor in a patient who formerly showed other cysts diagnosis can be made. I do not think that Weinburg's reaction or eosinophilia repeatedly weak or negative facilitates the diagnosis.

As regards treatment I think that vaginal or abdominal hysterectomy according to the conditions of the patient (age general state dimensions of the tumor vaginal amplitude infection etc.) will be the intervention of choice.

In the case of women capable of being impregnated and except when the cyst is very small cystectomy alone will suffice but the presence of a cavity which in the majority of cases must be drained singularly weakens the wall for the evolution of pregnancy. Moreover in cases of prolonged drainage a peritonitis with consequent adhesions is produced which brings about a spontaneous abdominal hysterectomy with all its inconveniences.

Finally I think cystectomy with partial uterine resection is indicated only in the case of very small hydatid cysts.

The prognosis judging by the published observations is not bad when patients have been operated upon before the cyst becomes infected. In our patient the evolution of the case made us think that the last pregnancy co-existed with the cyst without producing any complications.

DEPARTMENT OF TECHNIQUE

THE PARAFFIN-WAX OR CLOSED METHOD OF TREATMENT OF BURNS

B. WILLIAM O'NEILL SHERMAN, M.D., F.A.C.S., ET AL.

APIIUSAL of medical literature reveal the fact that almost every drug, in the pharmacopoeia has at some time been used in the treatment of burn. There are countless ointments, mixtures and methods in use today all having numerous specific and general merits for their particular efficacy.

It is true that the discovery of antiseptics and for some time afterward carbolic acid was the method of choice. The difficulty of keeping carbolic acid aseptically caused it to be generally discarded for pyrocatonic normal saline boric acid ointment boric acid lotion and the open method.

Nine years ago the writer and his associates in the Carnegie Steel Company attempted to standardize a near approachable treatment of burns. At that time there were many conflicting opinions and it was with difficulty requiring much persuasion that we were able to reduce the choice in number to treatment from 15 to 4, i.e. pyrocatonic normal saline boric acid ointment or solution or open method with dusting powder of terebenthine zinc and boric acid.

The same general conclusion and understanding was reached throughout the profession in the treatment of burns. There has never been any attempt at standardization because there was little to choose from the various methods, none of the methods being satisfactory and all leaving much to be desired from the standpoint of the patient and physician. Notwithstanding this state of affairs the general conclusion of medical opinion was that the best results were obtained upon what should our standards be based. Needle to us the method which relieves pain and promotes rapid healing with a minimum of cicatricial tissue is the method of choice.

During the past even year the writer and his associates have treated 31,445 first and second degree and 4,683 third degree burns. We have thoroughly and conscientiously tried every known method. For the ambulatory cases boric ointment and pyrocatonic 50 percent solution seemed to give the same results. The hospital

bed cases have been treated with the open method dusting powder followed by dry heat and boric ointment etc. as this method seemed to cause the least pain and discomfort to the patient. The removal of gauze which becomes encrusted in the burned surface and granulations is a very painful and barbarous procedure and should be condemned. The continuous bath treatment does not offer any special advantages over other methods and is difficult to carry out where there are a large number of burns to be treated.

One of the basic principles in the treatment of burn has been to exclude the air. This cardinal fact has been well known for centuries. Notwithstanding this recognition principle not until Bartholin's Sanifordt pyrocatonic mixture of paraffin and resin (ambrine) were we able to apply a satisfactory dressing which actually excluded the air.

Sixteen years ago in China Bartholin de Sandfordt first applied his paraffin wax for the treatment of burn. The result secured caused him to experiment further in the use of these mixtures. Finally a combination was perfected and placed on the market under the trade name of ambrine. Five years ago this mixture was made to market through product and introduced the treatment in the United States. They met with failure first because the principle advanced were contrary to previous theories and practice second the treatment was inadequate for condition here it was of questionable value third it was a patent infringement. The attempt to popularize the method in France and the United States met with medical opposition and financial failure. Bartholin de Sandfordt was locked up in a crank and in consequence the method fell into disrepute. The method was unknown in this country despite the fact that the opponent to the method claimed it was not new. Today those who offer the most objection and adverse criticism to the method have not even applied it on a large series of cases and are ignorant of the cardinal principle underlying it. They maintain that it is all wrong.



Fig. 1. Gas burn, second and third degree. Photograph taken on fifth day. Cured in 33 days. No cicatrices.

simply because it is contrary to their theories and former ideas and because it is a new method. Like every new discovery in medicine it has had a certain amount of prejudice to overcome. We have frequently been led to expect so much from various new discoveries only to have our expectations rudely shattered that it is only natural that the efficacy of this treatment should be questioned.

Very few who have witnessed this treatment at first hand have failed to acknowledge its unquestioned superiority over every other known method. It was not until the present war that de Sandfordt was privileged to treat a large series of cases and prove the merits of the method. The writer must confess it was not without misgivings and doubt that he visited the hospital at Issy les Mouligneux where de Sandfordt was treating a great many burns of all degrees. However, the results obtained were self-evident and spoke eloquently of the new method and it was not difficult to forget former theories and ideas. There was no alternative.

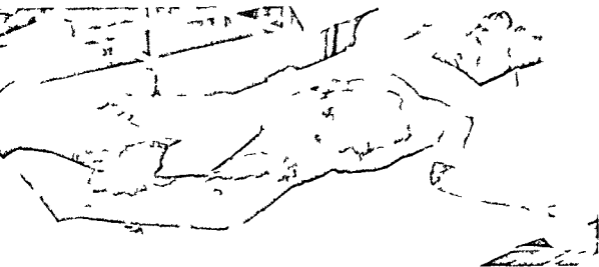
To seal up an infected burn was thought to be contrary to all sound surgical principles. Notwithstanding this the patients were being dressed



Fig. 2. Gas burn, second and third degree. Photograph taken on fifth day. Discharged from hospital on twenty-first day. Cured in 31 days.

without pain; they were recovering two to three times more rapidly than under former methods and free from cicatricial contraction with a minimum of scar tissue. It must not be assumed that all third and fourth degree burns heal without any scar tissue formation. There is some scar tissue, but it is infinitely less than with any other method and does not have the tendency to contract so that the frightful disfigurements and loss of function are practically eliminated.

After the first 24 hours the patient is free from pain in the vast majority of cases. Thus one factor alone justifies its use. The objection to the method as used at Issy was the great amount of time consumed in doing the dressings. By improving the technique this objection has been overcome. Upon the writer's return from Europe in November 1916 immediate efforts were made to improve the technique at the present time even the largest burns can be dressed in 5 to 8 minutes without much discomfort or annoyance to the patient. We have treated more than three thousand cases to date and find this method superior to all others. It is now in use at every one of our emergency hospitals as a standard treatment. The men have learned from the experience of their fellow workmen the superiority of the paraffin method and ask for it.



I g y Cl l l k 4 dmtt l O t b e o S l l t l d d k l S t l f t t m f d
n t b d m t m d t l g l Th t y th t 4 l t t l d l g t S t p e t f b d
h l l f 4 th t g f t g C m l t t t t t t f k k f t k v l m g Th
l d t m p e t l l m l t l t l h l f k N d l m

It is useful to compare this method with other methods because of its undoubted superiority as an ideal treatment for burn

INDICATIONS OF TREATMENT

All burn regardless of character are thoroughly cleaned and an air tight coating of paraffin wax is applied to the burned area including one half inch of the immediate margin of skin adjacent to the burned area. A thin layer of cotton is then applied which is incorporated into the first film of paraffin wax by painting with a fine arm brush sufficient wax to completely immerse the cotton. The wax set in a few seconds. The dressing is then completed by covering the entire waxed area in cotton and gauze. All burn are treated every twenty-four hours. The wax method does not contain any specific curative medical ingredients but acts entirely mechanically allowing nature to heal under conditions favorable to repair. The wax cotton dressing is a non-alcoholic shell which excludes the air maintaining a constant temperature and form a protective dressing to the proliferating tissue under the best physiological condition allowing regeneration and re-epithelization along natural lines. The wax gives a superstructure or scaffolding and protect the new epithelium which rapidly regenerate. The dressing serves as a poultice plugging and holding at the site the traumatized tissue. In a short time excretion form under the dressing which makes

it non-adhesive and easy to remove without jamming. In the early days of the new regenerated epithelium thereby facilitating the healing without apparent contracting cicatric and without any functional disability. Any paraffin wax which is neutral and has sufficient elasticity and ductility so as not to crack after it is applied will give good results.

PHYSICAL PROPERTIES OF PARAFFIN WAX

Ambrine is a neutral paraffin and recommended which is prepared according to a secret formula. On account of its organic composition it is impossible to analyze. There are a great many imitations on the market including cere lent mulens paraffine redintol tanolind Colonel Hull formula etc. Many of the preparations are mere mixtures while others are specially prepared pharmaceutical products. The wax should be neutral and non-irritating. Paraffin ordinarily contains a trace of sulphuric acid. Beeswax contains 1 to 15 per cent cerotic acid and petroleum contains 10 to 20 per cent various organic acids. The acid should be removed so that the base paraffin wax is neutral. The proportion of material entering into the combination should be such as to insure a low melting adhesive non-brittle elastic ductile wax. The wax if properly made is a refined pharmaceutical product and not a mere mixture of paraffins. To the wax base petroleum oil of eucalyptus beta naphthol can be added in proper amount.



Fig. 4. Several second degree burns face and hand with slight third degree gas burns June 4 1906. Completely healed in 35 days July 18 1906. Note absence of cicatrices.

Several different kinds of wax should be available basic wax containing resorcin and eucalyptus can be used to advantage.

Ambrine is a very excellent neutral wax having ideal physical properties. Its value can be improved by adding any of the above mentioned drugs. The formula of Colonel Hull known as No. VII is more brittle than ambrine and does not adhere to the granulating surfaces as well as some of the other wax preparations and also contains olive oil which at times become rancid. The advantage of the Hull formula is the use of oil of eucalyptus and beta naphthol which seems to hasten repair in certain cases and reduces the objectionable odor to some extent.

Paraffin is a very poor solvent for resorcin chlorazene beta naphthol and especially poor for picric acid while neutral beeswax is a very good solvent for these drugs. It is practically impossible to incorporate any appreciable quantity of picric acid in ambrine which is largely paraffin base. There are many grades of paraffines in which there is a wide difference in physical properties.

A neutral flexible wax containing resorcin or oil of eucalyptus will give equally good results. The picric acid should be dissolved in the beeswax and every precaution taken to prevent its settling to the bottom as it is likely to cause an explosion. Certain of the substances contained in the paraffin mixture fall to the bottom when heated. This is an objection and would not occur if the ingredients were properly introduced. They should have a common melting point and same relative specific gravity.

A properly prepared pharmaceutical product is solid when cold (very much the same gross physical appearance as beeswax) and becomes as thin as water when heated at 140 to 150 °F. It has a very low melting point. Heating 8 to 10 minutes to 250 to 60 °F renders it aseptic. It is analgesic and relieves pain almost entirely after the first 4 hours. The discomfort during the first 24 hours however is less than with other treatments. The combination wax cotton dressing forms a shell which acts as a local incubator under which repair and proliferation rapidly take place.

METHOD OF APPLICATION

Equipment. Fine varnish brush or preferably a paraffin base atomizer, a double boiler, an electric drier, absorbent cotton divided into very thin layers.

When the patient enters the hospital the clothing is removed, blebs are punctured but not excised, and the entire area is thoroughly dried with a Shelton electric hot air drier or a Hamilton Beach fan so that there is no moisture on the surface (an electric fan or common fan may be used). The wax is applied to the burn at the earliest possible opportunity either with a fine varnish brush or atomizer, preferably with an atomizer. It is difficult to regulate the temperature where the brush is used; it is more or less painful and there is a tendency to brush away and traumatize the new epithelium and granulations. If a brush is used the wax should be gently daubed on without pressing to and fro painting movements are painful and should never be used. The frequent changing of brushes is also an ob-

jection. The wax can be sprayed on with an atomizer without pain or discomfort can be evenly distributed at a given temperature with no possibility of burning.

The atomizer is double jacketed with a water jacket keeping the wax liquid for thirty minutes after it has been thoroughly heated and may be operated either with a hand pump or a compressed air pump or air tank. The wax is placed in the atomizer and in turn can be placed either in an autoclave sterilizer or in a hot plate usually 10 minutes heating is sufficient to bring the wax to a proper liquid state. When a foul odor is used the wax can be boiled for ten minutes. One must be extremely careful to prevent the phosgene gas from entering the wax. A properly prepared wax free from water can be applied directly to a burn or granulating tissue at 100° F. with out further heating or burning. If the wax comes in contact with water it is more or less uncomfortable to the patient and the local treatment with granulation is a tightly

RULES

For the first two or three weeks or until the granulating area has a minimum of 5 and return the dressing should be changed every 48 hours but not more early than of the wound there is a rapid sloughing and separation of the tissue and a large amount of lymph which collects under the shell. The purulent liquid gently lift the wax from the wound so that it is not adherent to the tissue and frequently drain from under the edge of the dressing. The wax shell is readily removed with out pain by lifting it from the edges or by making incisions with a scalpel through the shell and then gently peeling off the shell. The shell lifts off very readily. The

wound will be found to be freely bathed with lymph and a purulent secretion and in the early stage there are sloughing masses which at times become very offensive. This odor is in contradistinction to the continuation of the treatment. The wound is then gently cleansed with a mild antiseptic solution (saline or boric acid solution) great care being taken so as not to disturb the fine film of epithelium which rapidly starts to grow from the edges of the wound. Cotton ball can be used to wipe away the secretion. A more desirable method is to use an atomizer to clean the wound.

The entire wound is then thoroughly dried the granulations taking on a smooth varnished appearance and the wax is applied as in the primary dressing. At times the granulation continues to weep in spite of the efforts to dry. The excess of moisture can be removed with blotting paper. The dressing is then completed as previously described. The odor at times in the case burns is rather nauseating. Where there is a large surface third and fourth degree burn with extensive laceration and abrasion of tissues it is best to apply the Carrel Dakin or dichloramine T method to reduce the toxemia and abrasion after the toxemia has subsided the wax can be applied. One must change the treatment from time to time depending upon the pathological condition of the wound and clinical condition of the patient.

PRACTICAL FEATURES IN DRESSING AND RECOMMENDATIONS

1. At the first dressing burn should not be crumbed with antiseptic solutions. The tissue are sterile and are left for the burning and nothing to be gained by further traumatizing the tissue. Apply the wax at once merely ponging will not sterilize the wound if they are infected. Regard the antiseptic solution used.

2. Strong antiseptic solution should not be used in cleaning the burn or granulating tissue as dressing they should be comparatively weak. The strong antiseptic solutions tend to retard repair. Saline boric chloroform saline brilliant green or chloramine can be used in each solution (preferably in an atomizer).

The instructions should be carefully followed. Absorbent cotton should never be applied directly to the burn or wound as it tends to adhere and stick causing a burning sensation which is very uncomfortable to the patient. The wax applied alone is soothing and comfortable dressing.

3. The fetid odor and gray appearance of the wound when the shell is removed should not



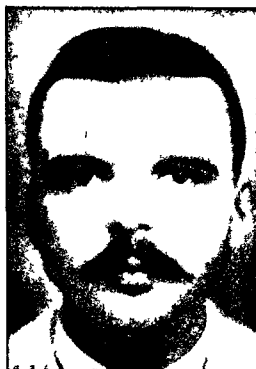
IIc I



II te II



IIc III



IIc IV

(Th P f W o C d M H d f T im t f Bt -W H O N H S)



Fig. 1. Very extensive second degree burn of both hands July 6, 1916 from liquid fire. Burns completely healed. No contracture present. Perfect function restored. August 20, 1916.

cause any undue anxiety. After the seropurulent fluid has been washed away and the sloughing tissues separate granulations with rapid proliferation of epithelium takes place.

e. It is impossible to burn the patient when the atomizer is used. The wax should not be applied at a temperature over 150° F where the brush is used.

f. In third and fourth degree burns with great loss of tissue granulations should be sterilized with Carrel Dakin method and skin grafted at the earliest possible opportunity. Grafting is not necessary unless there has been very extensive destruction of tissue.

g. The application of the heated wax encourages the flow of lymph, protects the capillaries and granulation tissue from trauma which is favorable to rapid repair.

Six months ago 15 people were burned as a result of the munitions explosion at Essington, Pennsylvania. Dr. I. C. Casselberry had an excellent opportunity to give the paraffin wax treatment a thorough trial as well as make comparison with other methods. He writes as follows:

We consider it far superior to any other method that has been instituted for the treatment of burns. In the first place from the standpoint of relief of pain as soon as possible and the ease and comfort compared to other methods in the changing of dressings to my mind one of the greatest advantages. The persistent mental and physical condition improve so much and rapidly when the treatment of the redness is mitigated as they are under this mode of treatment. Some of the cases which have been in my private to the application of the paraffin wax were put back to bed and not to the pains of a minute. I cannot recall but one or two very bad cases in which we had to operate and then only to relieve the mental distress directly following the explosion and not so much for the actual pain involved.

When the hands and feet were completely healed the skin technique was used after the discharge was under

control paraffin wax was again used. The first and second degree burns healed very rapidly leaving a bluish to the surface but no scar. The skin was soft and pliable with no tenderness. In most of the cases of this character the skin at this time August 19, 15 weeks after the accident has assumed its natural color and texture. In the more deeply burned cases there has been some elevated scars but very moderate in comparison to the cases treated by oil or other methods. In fact I have seen some of the scar left by the old method that seem to be criminal. These scars are very much raised and exceedingly tender which is not the condition where the paraffin wax has been used. Another great advantage is that there is scarcely any contraction of the skin or tendon. Some of the cases treated with other methods are very much disfigured and in many cases the contractions are so severe that there will always be a limit to their movement and consequently their value as working people is impaired permanently.

In no instance did we have to resort to skin grafting and there were some very extensive burns including all parts of the body. I have had practically no trouble following in cases which were treated with paraffin wax but in the other I have had painful contractions to contend with some of the latter have had ugly scars of the face but not one of the paraffin treated burn of the face left a scar or contraction.

We used 3 different preparations. The amine treated cases showed up best of all. I do not speak ill of any of the paraffin preparations for I feel that any kind of paraffin is superior to other methods.

To sum up I would say the advantages of the paraffin wax treatment are:

1. Relief from pain to a great degree.
2. Clean and more comfortable.
3. Few scars and contractions.
4. Skin grafting rare.
5. More rapid healing.
6. Superior in every way to other methods commonly used.

GROWING NEW SKIN IN AMPUTATIONS OR GRANULATING WOUNDS

Experimentally we have succeeded in growing new skin over amputation stumps. It is very questionable whether this method is advisable in these cases. Sterilization of granulations



The patient is lying on the table, and the surgeon is performing the operation. The leg is held in a position that allows for a clear view of the surgical site. The surgeon is wearing a white coat and is focused on the task. The patient's face is visible, showing they are looking towards the camera. The background is slightly blurred, focusing attention on the surgical procedure.

followed by skin grafting will give a more satisfactory functional result and materially reduce the convalescent period. Where the granulating area is too small to warrant skin grafting, paraffin wax can be used. No skin can be grown with surprising rapidity. It is also of value in the treatment of trench feet and frostbite. The best results are only possible where sound surgical judgment is exercised. Paraffin wax is not a panacea or cure-all, but if used with discretion and judgment is a valuable treatment.

BACTERIOLOGY AND BACTERIOLOGY

During the sloughing stage a mixed infection is always present (staphylococci, streptococci, bacillus fetidus, subtilis, proteus and other aphrophyte) are to be found with a profuse milky, oporulent fetid discharge. The sloughing tissue rapidly separates through the proteolytic activity of the leucocytes that are thrown out from the underlying granulation tissue. The

granulations suddenly make their appearance. The skin growing from the islands and edges of the wound rapidly proliferate new epithelium. Where there has been total destruction of skin (third and fourth degree burns) the skin grows only from the edges. Upon close examination a fine film of epithelium can be seen growing around the edge of the wound; this is due to the rapid proliferation of epithelium. It is difficult to say why the cicatricial tissue which forms wherever granulation tissue is present (during the process of healing) is free from contraction unless it can be attributed to the bland and non-irritating character of the dressing and the optimum conditions afforded by the paraffin film for the protection of delicate epithelial cells (a property of paraffin taken advantage of in the protection of endothelial and blood cells in transfusion work). It is a well known fact that nature responds to irritation by the proliferation of cartilage tissue. The daily application of the ordinary

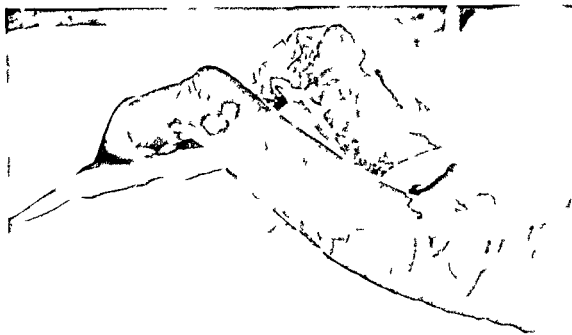


Fig 8 Mrs Anna S age 6 admitted November 1917 Third degree burn of the abdomen 80 per cent burned Annular burn of the left leg third degree 95 per cent of the thigh involved Annular burn of the right thigh third degree 75 per cent of the area involved Photograph taken January 14 1918 with 50 per cent of the area healed

gauze dressing while unfavorable to the proliferation of the first delicate film of epithelium furnishes the mild irritation which nature recognizes in the usual way and the end result is a thick layer of scar tissue that gives rise to the distressing contractures so frequently met with as an after complication of burns

The new film of epithelium can be seen growing up and over elevated granulations these raised granulations are sometimes $\frac{3}{8}$ of an inch high When the skin grows over the elevated granulations they become flat and even with the surface The resulting cicatrices are very flexible compared to cicatrices treated by other methods In no case have we seen a scar interfering with function It must be remembered however that all cicatricial tissue has a tendency to break down if the circulation is in any way impaired

Bacteriological charts (Carrel) have been kept for observation purposes In the early stages the bacterial count (on smear) is usually very high (above 90) During the later stages the number of microbes found in the granulations decreases The granulations are never sterile (bacteriologically) unless treated with Carrel's technique No attempt is made to differentiate the bacteria One must be able to distinguish between a clinically sterile wound and a bacteriologically sterile wound Theoretically all wounds are infected and contain bacteria

GRANULATIONS

Granulation tissue rapidly appears under the shell and does not bleed when dressing is removed at times it is very abundant and elevated It should never be cauterized with silver copper sulphate or any other caustic We have never found occasion to use a caustic The new epithelium that forms crowds the granulation tissue down in such a manner that it leaves the healed surface soft and pliable the newly formed skin frequently taking on the gross appearance of normal skin These granulations are not sterile On bacterial smear numerous bacteria chiefly cocci and spheroophytes will be found in the field Should the granulations become sluggish a wax containing resorcin oil of eucalyptus or beta naphthol can be used for the stimulating effect The Carrel Dakin method if applied will rapidly decrease the number of bacteria in the field causing the granulations to change their gross appearance and take on a compact firm healthy appearance Where there has been a large surface destroyed (third and fourth degree burns) the repair at times becomes stationary This condition becomes more evident in the later stages of the repair the reparative process becoming slower in later stages and is in proportion to the size of the granulating area

In the large third and fourth degree burn the granulations can be sterilized (Carrel Dakin) after all sloughing tissue has been removed and



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thin skin graft (The Carrel-Dakin method). Following skin graft the area can be treated by following the Carrel-Dakin technique using 0.25% silver nitrate solution. The method has been tried at various places fully with success. Should the granulation be on pile and slowly growing, no tendency to repair some underlying constitutional condition (frequently syphilis) can often be found. By treatment of this condition repair rapidly takes place.

INFECTED AND STERILE BURN

A distinction must be made between clinically sterile and bacteriologically sterile burns. Burn are clinically sterile but bacteriologically infected. The first few hours following the receipt of the burn then all become bacteriologically infected. In a few days the burn begins to slough or become necrotic. Smaller burns will have a larger number of epithelial cells and cells which are frequently in contact with the skin. It will thus be seen that practically very few burns are infected at the time during the course of healing. This low grade infection is always present in necrotic sloughing tissue. It is not common to find repair but some to the part of the physiological process of repair. To call upon an infected burn that in no way free drainage interfered with has heretofore been considered a surgical error. Should there be clinical evidence of infection with elements like lymphangitis or pyemia with pain acceleration of pulse and high temperature, the wax treatment should be stopped immediately and a Carrel-Dakin dressing applied until the infection has clinically subsided and been confirmed by bacteriological smear after which the wax can be applied. Where new skin is to be grown and skin grafting is not indicated the wax can be used after the granulation or infected wound has been sterilized with the Carrel-Dakin method.

New skin has been successfully grown in amputation stumps in a remarkably short time after the granulations had previously been sterilized with Dakin solution.

CHEMICAL, ELECTRIC AND X-RAY BURNS

Chemical burn. If the burn is acid an alkali neutralizes the acid present and if alkali an acid neutralizes the burned area thoroughly dried and wax applied. We have had several acid burns first and second degree in which 5 percent surface of the lower extremities was involved which were cured and the patient in each case was discharged from the hospital in 11 to 12 days with absolute freedom from pain during treatment.

X-ray burn. Experience is too limited to express any opinion other than the relief from pain which the dressing affords. Mayo reports one case in which an excision had been done for a sluggish burn of more than one year's standing in which the granulating wound covered over satisfactorily with the wax treatment. It will probably have some value in the treatment of X-ray burn.

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l t l g l t t f t h l l l f l f
l l p l t l t t d t h n m m l t l y
l l d d t t t b l t l p r y g l t f t
l f t l p l t t h l a l g a g r d u l T l p a
t t t l h k l 4 k t h m l t l l k f
t l d
C S l k b r f t h l f t d l k
l t m t f t h l y p t l l l k f t h
l l l l l h d m t T l p f
l l l t t h f l t f t h b l t y f
t h l t t t t l f t t t t m t d
t h j u l l t t t d t S h p t d
k l t t h l l m f l t l y h l d t a t
t h t t t m h b g n t l t m t d d h
l m l h d t b n y t t t h
f m l l l k

Electric burns. Hiltze reports excellent results in the treatment of electrical burns (30 cases). I am was relieved and patients recovered more rapidly than with other method with no contracting cicatricial tissue. He considers the method far superior to other method and has standardized it in his clinic.

SKIN GRAFTING

This procedure is much less frequently resorted to as the great majority of burns heal without it. Where there have been large areas of com-

plete skin destruction grafting will materially reduce the convalescent period. The grafts should not be applied however until the granulations have been sterilized (Carrel Dakin) the average number of bacteria being 1 to 4 microscopic fields. If skin grafting is resorted to with ambrine treatments many of the grafts will fail. The best results are to be secured by sterilizing the granulations then grafting (Thierch) this to be followed by Carrel's technique using Dakin's hypochlorite. It is quite possible that weak chlorazene or chloramine T or fuvine will give equally good results by keeping the grafts moist using Carrel tubes and technique. Our cases are as yet too limited in number to say definitely which of the after treatments is going to be the most successful.

The paraffin wax treatment was used in six cases immediately following the grafting of skin with 75 per cent successful grafts. In four cases the application after skin grafting caused a blistering or tendency to break down the grafts. After the granulations have once been sterilized every effort should be made to keep them free from reinfection. This cannot be done if the wax is used as a sterile wound in 24 hours will show 60 or more bacteria on smear to the microscopic field.

Our late plan of after treatment is to carry out the principles of Carrel's technique using Dakin's hypochlorite solution. The results secured by this method justify a continuation with hopeful anticipations. The after dressing when this technique is used is quite striking when compared to the physical appearance of dressings treated with former methods. They are clean and dry and odorless free from wound secretion and sloughing grafts.

Further experiments in the after treatment will undoubtedly develop an improved method which is sure to result in a larger percentage of skin graft successes. It must be borne in mind that one cannot tell from the physical appearance of a granulating wound whether it is infected or not. They must be smeared and the bacteria counted. A wound which might appear

to be sterile to the naked eye might be infected and a wound which might seem to be infected may be sterile upon smear examination.

It is unfortunate from all viewpoints that ambrine is a secret preparation being the property of the Ambrine Company of Paris. It is to be hoped that the formula will be given to the world gratis because the valuable physical properties of ambrine are almost ideal. Certain of the substitute waxes have satisfactory physical and medicinal properties. This is due to the composition and methods of manufacture. They should be neutral non brittle elastic flexible and adhesive and should contain just enough oils and antiseptics to reduce the obnoxious odors and promote stimulation of the newly formed skin. Burns of all degrees heal far more rapidly than with any other method. Pain is reduced to a minimum and healing takes place without contracting scar formation. First and second degree burns usually heal entirely in 12 to 18 days constitutional symptoms rapidly subside. Many patients recover who would have died under former methods. This opinion is concurred in by all who have had an opportunity to study the treatment. The skin rapidly proliferates from the edges of the wound and from the islands of epithelium which make their spontaneous appearance three or four weeks after receipt of the burn. These islands rapidly grow and coalesce with the growing skin edges or adjacent islands. They begin as pin point grafts rapidly growing to large size islands. The relief of pain alone justifies its general adoption. Anesthetics and sedatives are very rarely necessary. The rapidity of repair, relief of pain, absence of contractile cicatrices (scar tissue) is present but it does not cause serious contractures and deformity. Absence of local and constitutional symptoms is so remarkable as to be difficult to believe. This method is being used very extensively in the Allied armies and navies. It is to be expected that this method will receive universal recognition and be made the method of choice in the treatment of burns until a superior method is discovered.

SOME FURTHER NOTES ON THE TREATMENT OF BUNIONS¹

BY JOHN L. PORTER, M.D., F.A.C.S., CHICAGO

In my earlier article I described an operation for the cure of bunions. Since that time I have performed a great many operations employing practically the same technique and I am happy to report with excellent results.

Many operations undertaken for the relief of bunions are unsatisfactory and disappointing at least for the patient concerned. Why? Because they fail completely to correct the deformity or else they leave a stiff joint or both. There are three reasons for the imperfect result: may be any one or more of five, viz: (1) failure to remove enough bone from the metatarsal head; (2) removal of bone from both of the joint surfaces; (3) failure to remove all the bony tacks to correct the deformity; (4) failure to maintain sufficient rest after the operation; (5) failure to see that the patient is properly healed after recovery from the operation.

The most common and most potent reasons for failure are the first two. If insufficient bone is removed the deformity cannot be corrected. Although all the other precautions are observed, if too much bone is removed from both metatarsal and phalangeal surfaces a stiff joint will surely result.

Another important obstacle to reduction of deformity that is most frequently overlooked is the shortened tendon of the extensor hallucis longus.

With the idea of trying to avoid all the causes of failure I devised the following technique and have followed it exactly in practically every case. I do not know how many during the past twelve years without having one dissatisfied patient.

A constrictor may be used but of late I have found it unnecessary. After a thorough preparation including painting the foot with iodine a crescent-shaped incision two inches long is made just below the edge of the callus which covers the enlarged head of the metatarsal (Fig. 1). I found after several experiments that this incision gave freer access to the joint at exactly the point where the bone is to be removed than any other and the resulting scar is just between the points where the upper and sole of the shoe make pressure. I would say at this point that the frequency of occurrence of a true bursa in this region has been greatly exaggerated.

The capsule is incised in the same direction and to the same extent as the skin and the capsule and periosteum are dissected free from the bone by means of an instrument devised by my associate Dr. I. Lewin and called a bunion dissector (Fig. 6). The capsule is always adherent to the upper surface of the bone but never to the lower.

The edges of capsule and periosteum are retracted and with a flat chisel and a properly balanced wooden potato masher for a mallet two thirds to three fourths of the head of the metatarsal is removed at such an angle as to include all of the

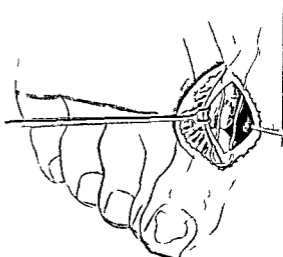




FIG. 3 Illustrate a pair of feet before and after a typical operation as described above

enlarged inner tuberosity. I do not remove all of the head of the bone for three reasons (1) It is not necessary. The deformity can be perfectly corrected without doing so. (2) It does not shorten the inner border of the foot and thus make it look unnatural. (3) Motion will be more free if some of the articular surface is left.

After the bone has been removed and all the rough surfaces smoothed the toe is pulled strongly inward and the tendon of the extensor hallucis longus which is thus brought up into prominence is divided subcutaneously at the level of the joint. Then it will be found that the toe can with very little pressure be made straight. Occasionally I cut the capsule on the opposite side of the toe. This can be done with a tenotome. If a constrictor has been used it should be removed at this time.

While the toe is held in its corrected position a mattress suture of strong 6 to 40 day catgut is carried from the lower angle up to the upper angle, returned through the upper angle and brought out at the lower angle (Fig. 2). The suture is tied thus approximating the upper and lower angles of the capsule incision and if the proper amount of bone has been removed and the tendon divided when that suture is tied the toe will remain straight. If necessary the calloused skin over the bunion may be removed.

The skin wound is then closed with waxed silk, horsehair, silkworm gut or catgut. Thiersch powder is dusted on and a thin gauze dressing applied. The tenotomy wound can be closed

with one suture. Over the dressing I put a piece of piano felt with a hole in it shaped like a bunion plaster and a padded cigar box splint a trifle longer than the foot and somewhat wider than the toe is fastened to the inner border of the foot with adhesive plaster.

The splint is then covered with a bandage starting at the ankle, the splint being fastened firmly to the foot and the toe fastened firmly to the splint with adhesive.

If the other toes are bandaged so as to approach the big toe the patient will usually feel more comfortable. When the patient is returned to bed the feet should be elevated on pillows and a cradle used to keep the sheets away from the toes.

If the patient is going out from my observation I apply a plaster of Paris cast over the dressing. In many cases where the entire metatarsal arch is dropped I apply a plaster of Paris cast exerting pressure under the arch by means of felt pads.



FIG. 4 Same case as shown in Fig. 3 before and after operation

EDITORIALS

HOSPITAL STANDARDIZATION AND TOO MUCH SURGERY

NO law is such bad law as too much law said a judge years ago in the analysis of a case before him Too much law is no doubt bad enough but when the principle is true in surgery the surplus costs human health and even human life Through medical literature and through the proceedings of medical societies for many years has sounded an insistent voice a voice without the tone of oratory which interrupts and interrupts again Unnecessary surgical operations the voice says and operations performed by untrained men are familiar to all of us What are we to do with the charlatan with the daring unsafe and unprincipled surgeon? The voice has created many an awkward pause but through a score of years no answer

Finally an answer has come The American College of Surgeons in its plan of hospital standardization makes a straight drive at too much surgery The plan of the College is neither sentimental nor whimsical With the good will and co operation of hospitals the College directs attention to facts What was the matter with the patient? What did the doctor do for him? Was the patient relieved or cured? If not why not?

In other words the College takes up the keeping of case records and the analyses of these records as its first factor of hospital standardization It says Consistent and fearless review of case records by the hospital staff is a just and effective means to deal with incompetent medical and surgical work If the facts establish evidence that a physician

or surgeon is unsafe in judgment unworthy in character untrained lax lazy or careless in all honor and decency that individual should either overcome his deficiencies or withdraw from practice Certainly he should neither ask nor receive the privilege of practice in a hospital

Thoughtful truthful analyses of case records surely take us to the very aim of the whole profession and of hospitals Was the patient relieved or cured? If not why not? Here we have a test of efficiency that is fundamental It is a test that is sound simple and direct If now the hospitals earnestly carry out the plan in a comparatively few years the untrained and the unprincipled surgeon will find no hospital home in which to operate as he is now in many instances free to do Already the public with determination insists upon such efficiency in hospitals

Elsewhere in this issue of the Journal is a more complete statement of the College in this connection That statement recalls to us the homely truth that in almost every community there is a man or two who minds his own business and who seldom has his name in the local papers He pays his debts he sees to it that his neighbor is not in want and he brings up his children with due reverence and obedience If his country needs him he is ready He is all common sense The hospital standardization plan of the College seems to have sprung out of the common sense of just such men It touches only upon the essential things which make for the proper

care of patients For this reason it is a sound beginning and it draws no false lines

The purpose of these paragraphs is to urge that each doctor whether or not he is a Fellow of the College appoint himself as a committee of one to see that the plan be carried out in the hospital or hospitals with which he is associated There is no such thing as a miracle person who can do all the work nor who can alone change existing conditions in the practice of medicine Hospital standardization is an evolution It is the work of thousands and not of a few

Again the College asks that the hospitals meet squarely the practice of division of fees A farmer was asked what he did through the long winter months Oh I set and think he replied and sometimes I just set As for the division of fees it seems that sometimes hospital boards of trustees and hospital staffs just set During these nap

times the evil had crept in and become established before many of the hospitals were aware of it If a hospital is open to fee splitters it should be willing to say so and the people of its community have a right to know what this means to them

But the patient the patient the patient! The right care of patients is the aim of all practice of medicine and of hospitals It is the beginning and the end of hospital standardization and the College clearly emphasizes this view Let us get to the true facts as to what we do for patients and analyze those facts ' The integrity of the profession requires that each hospital determine whether or not its cases are successfully treated and if not why not the College states That is what the College means by standardization The entire work depends upon constant earnest effort and sound training rather than expenditure of money

TRANSACTIONS OF SOCIETIES

CHICAGO GYNECOLOGICAL SOCIETY

REGULAR MEETING OF THE SOCIETY HELD FRIDAY JUNE 15 1917 WITH THE PRESIDENT
DR CHANNING W BARRETT IN THE CHAIR

ABDOMINAL TUMOR CAUSING INTUSSUSCEPTION PROLAPSE OF PELVIC ORGANS IN A NULLIPARA

DR CHANNING W BARRETT The specimen which I wish to call the attention of the members of the Society was removed from a young colored woman 35 years of age who entered the Cook County Hospital with a diagnosis of pelvic cellulitis. There was a very active discharge from the vagina, the rectum, large and small intestines, and the uterus firmly fixed in the pelvis, and the esophageal condition around the uterus. She had markedly distended abdomen. The leukocyte count was 10,000 on admission, which fell to 2,400. It was thought from her general condition that he had a pelvic infection, the infection traveling to the peritoneum with peritonitis, and more or less general peritonitis, and that this accounted for the distention of the abdomen. She was put upon expectant treatment, but she developed a condition of appendicitis, and began to vomit fecal matter. We were forced to operate, although she was not in a good condition to stand the operation. At the operation the small bowel was found about 10 and one-half inches in diameter. It was found that the small bowel disappeared in a depression on the side of the large bowel. The specimen shows the cecum with an intussusception of the small bowel into the large, but the interesting feature of it is that the lowest point in the intussuscepted portion contained a hard nodule, which was first thought to be a portion of the bowel molded into that form. Upon further investigation it was found to be a very hard tumor attached to and depressing the wall of the bowel so that the tumor projected into the lumen causing the intussusception. A peristaltic wave caught the tumor, drew it on, and drew the bowel along until it was drawn into the large bowel. That is the interesting feature about this case.

This patient died promptly after the operation, but it is probable because of her condition that she would have had a better chance of living if we had just operated on the small bowel and attached it to the abdominal wall and done nothing more at that time. Then if the patient had lived there would now be a fecal fistula open upon the abdomen and this

intussuscepted portion of the bowel in the cecum and colon, which would not be a very ideal condition. What we did was to resect the intussuscepted portion and plant the small bowel into the sigmoid.

I have seen one other case postmortem in which a tumor had been the cause of intussusception. The specimen taken from this case shows it to be a fibroid, and although it projects into the lumen it is really in the bowel wall because a portion of the bowel wall covers the tumor.

Another case which I wish to report briefly is that of a woman 42 years of age operated on this morning. She claims never to have given birth to a child is not married and claims not to have been pregnant. Anatomically the conditions bear out that statement particularly the cervix, the perineum, the absence of striae and so forth. But she has suffered from prolapse of the pelvic organs since her marriage might say. She has been operated upon twice before and that the patient had no children, therefore it was assumed that there was no injury to the pelvic floor. She had been operated on abdominally, but nothing was done perineally for the prolapse. There was a return of the prolapse each time. We found the levator ani muscles lying well to the side with plenty of opportunity for a hernia. She dates her trouble from an injury received by slipping while lifting. She felt a giving away of something the same as a patient often times does who has an inguinal hernia. The fact of the matter is that probably she had a weak pelvic floor and the lifting or injury was only accessory to that. At any rate she needed repair of the pelvic floor just as much as a patient who has borne a child.

CARCINOMA OF CÆCUM RECURRENT PRO- LAPSE

DR EMIL RIES The two cases reported by Dr Barrett bring to my mind two cases I have had. One came to me with the implant of a movable tumor in the abdomen. It was sometimes in the region of the epigastrium and sometimes in the region of the right hypogastrium. I observed her for a few days and then I opened the abdomen. I found the following picture: the ileum entered the transverse colon about its middle. There was no cecum, appendix, or end of colon or right half of the transverse colon, but it was possible to

draw the bowel back and return the intussusception I resected about three inches of ileum the appendix cæcum ascending colon and right half of the transverse colon and attached the ileum to the transverse colon. That was four years ago I saw her last week. She had gained over 30 pounds and was in perfect health. The specimen showed a carcinoma of the cæcum which protruded into the lumen of the bowel.

The second case reported by Dr Barrett reminds me of a patient on whom I operated ten days ago. She had a recurrent prolapsus and when she came to me I diagnosed a hernia of Douglas pouch. The cavity of Douglas pouch went clear down to the perineum so that the rectum and vagina were not attached to each other as they should be. The peritoneum was stripped up to the height of the cervix and tied off as we tie off a hernial sac and stitched the posterior wall of the vagina which I had split longitudinally to the rectum. The patient made a good recovery.

I think these congenital deep cul de sacs are not generally known and the only American author that mentions the condition is Reynolds who discussed it in a paper on prolapse some time ago. These hernias are a comparatively frequent source of error in the diagnosis of prolapse.

CYSTOCELE

DR THEODORF J. DOEDERLEIN With reference to cystocele I was interested in an article I saw in a surgical and gynecological journal by a New York man who described an operation of lifting up the bladder internally. I did that in two cases ten or fifteen weeks ago in women who had been operated on twice for cystocele. I amputated the cervix made a high perineorrhaphy, lifted up the bladder internally as though doing a hysterectomy and brought the broad ligaments together as described. It seems to me that is an ideal operation. If the tissues hold quite well the uterus stays up. It is rather early to report these cases as a success but the patients are walking about without my having done anything on the bladder below.

OVARIAN CYSTOMA

DR ALBERT GOLDSPOHN I wish to report briefly the case of a girl 14 years of age who had never menstruated who had attacks of pain in the third one of which I saw her. These attacks led the family physician to think that she had some abnormal development and retained menstrual blood. The child had become septic with a temperature of 101.2 white blood count 20,000 with a pulse of 130 and apparently a diffuse peritonitis. Examination showed nothing abnormal in development from below. If the tumor felt by the family physician was really retained blood then it could only be an abnormally closed horn of the uterus. But abdominal section showed it to be an ordinary ovarian cystoma springing from the right ovary developing

in the left side filling the entire pelvis but crowding the uterus toward the right with some five revolutions of the pedicle.

The odd thing is a cyst of that size in a child that had never menstruated. Before it was emptied its color was bluish black. The removal of the cyst was easy. The child is now in good condition.

URATE STONE IN TUMOR OF URETER

DR EMIL RIES The first specimen is from a woman who had painful urination for eight years. She had had an appendectomy and bladder treatment for cystitis but had not undergone a cystoscopic examination. She complained of frequent and very painful urination. There was some laceration some desensus of the uterus and vagina. On cystoscopic examination I found the right ureter normal. I could not see the left ureter because there was a tumor about the size of my little finger which was slightly warty and at the tip of which was a little crescentic opening. I tried to enter the ureter with a catheter but the catheter would not enter the opening. The tumor was movable. I could not find the ureter at the base of the tumor. I then did a suprapubic section exposed the bladder and found the tumor as seen with the cystoscope and when I took hold of it I found in the midst of the tumor a hard body which was a urate stone in the ureter. This could not be removed through the opening of the ureter without incising the tumor which was the inverted ureter protruding into the bladder.

LUETIC CONDYLOMATA

The second specimen is from a woman 57 years of age. There had been a bloody and purulent discharge from the vagina for about three weeks. She had not menstruated for several years. On examination I found two tumors close to the cervix and two lower in the vagina about an inch and a half long and three eighths of an inch high each. The question arose as to the possibility of condylomata in the vagina. The Wassermann test was negative but microscopic examination of excised tumors revealed typical luetic condylomata. She admitted then the probability of and examination proved the source of her luetic infection. The Wassermann test was negative because in the first stage of syphilis it is not as reliable as later. A Wassermann test has since been made and found positive and the tumors have disappeared under antisyphilitic treatment. Tumors in the vagina of this size are rare.

DERMOID CYST

The next case is the smallest dermoid I have ever seen. This small dermoid was on the surface of an ovarian cystoma of very large size. I operated on the woman for an ovarian tumor which contained a clear serous fluid and on microscopic examination the wall was devoid of epithelium evidently a

simple er us cy to ia but in the all on the outside I could e a little bleb ot th cker than half an nch a d about nche in c u mfe ence When I ope ed it out cam typical de moid material the fatty material of the derm d I l cut it pen a d ou n ee in the cent r i thc de moid the cha act stic de moid pe l h ll de m ds sho

ADENOCARCINOMA (F VACINA

An the pate it a ia 46 ve f ge ame to the M hael Rec H pit l c mplainng f r bloods d hars Sh lad a enl gel te u anl ympt m f cin a in the d f th ute u I d d a cur tiem itt n l the diag and im ediat ly g t talig clunk f rate il huch l ked cin mat u I f u n d it er t the pa th l g t f e m ation whl I nt n th d ald mual hy t ect n y The e were n u d al the gin c pt hat e male l ing the ett c t n tak gh l l fte v The c x a v d up bef e I did th ald mual hy ter t v Th n n ade a th re c v I l Pfann tiel inc n h h h l d l v fr n v t t i L ghteen th l ter the m n n t e mplanng le f l l l tum n th left l f the vag i When I l k e l s r th mull t or I fou l the ere t o m l l r l art l rely a large as the kernel f a h a l n t I concluded they ere cure n n a I m de a p v nal i n e t r p t d the en ti ag e ope ed the Pfa m n t i l n c and e t r p t d th ing ual gland completely O m m r p i c a m n t i o n I f u i d that both f these tumo in the agina h h v e separated by h l f a n h f t u e e t y p i c a d c a c i n o m a

Ho d a oman get a lenocarcinoma i the g a v a g n a that has trafited epithelium shoul ne r d e v l p a d e n o c a r c i n o m a l t t h s man m th m t a s t c i the agna e ghteen month lter n operat on f adenoc o m a f t l e b d y of the uterus I n the c u s e of operat on as ha l a p p e n e d m a n y c e before any ound is m d e i f f o i n t c t l e c c i n m r o p a d o n ith a Schuel ardt n c l on this n c i n m a y h a e m e a r c o m a t u s m t e i a l g r a f t e d i t o t b u t n th a e n o p a r a g i l n i n a m a l e t h e r n i j u r y t l e v g i n the p t i o r a l l v s p o t e c t e d b y p u l u n and the cer v a s v e d p b e f o r e e d i d the h y t e r c t v O f c o u r c u n d e r s t n d i n th a g a n a l t h g l a n d and s m a l l c y s t s a r e p r e s e n t O n e f the e c t i f d e n o c a r c i n o m a f t h a g n a h o v e d a t the d g e of the c c i n n a s n l l c y t t h s i n g l e l a y e r of c u b o d a l e p t h l u m b u t t h s c y t h a s u n d e r g o n e n o d e g e c a t i o n b a t e r T h e r i s n o t a c c e f p o l i f e r a t o n f the epithelium n t h c y t and t h e n o e v i d e n c e of c o n n e c t o n b e t w e e n t h c y t and t h c a r c o m a T h c c y s t i s a n a c c i d e n t a l f n d g b y the d e of the c a r c i n m a I f t h o m a n h a d c a i n o m a g r a f t e d i n t o h e r a g n a t i e y h a r d t c o n c e v t h a t t h a t c a r c o m a s h u l d h a v e r

mamed dormant for eighteen months and then developed into the e tumors I have examined the oman many times in the course of the e ghteen mont's because I wanted to be ure the carcinoma had healed I never found any tumor in the vag na until he came eighteen months afterward If he had carcinoma of the body of the uterus and had lymphatic metastases follow ng the lymphatics f the vagina and these metastas es grew out in the agna ve shoul d find me carcinoma in the l y n p h a t c of the vagina unde the epithelium in the ne gh b o r h o d of the tumors I have examined the tumo i n e a l e c t i o n s and have cut over five hundred e c t o n s f o m m a n y a c a s of the vagina but the e i s n o t a t r a c e of c a r c o m a i n t h e m

This case i remrkable because of the late recu rence All we can ay is that it s metastatic c c i n n a f r o m c a c i n o m a of the body t y p i c a l a l e c a r c i n o m a i the agina

I sh ull like to hear from the members as to lethe they ha e had imula case becau e I h a e n e v r e a d o r h e a r d f s u c h a c a e

Recu rence of the nature of implantation metastas n the agina six eeks or two or three mo ths afte o p e r a t i o n a r e f r e q u e n t b u t i m p l a n t a t i o n m e t a s t e e g h t e e n m o n t h s a f t e r o p e r a t i o n w i t h r e p a t e l n e g a t i v e e x a m i n a t i o n s i n t h e m e a n t i m e i m e t l n g n e w t o m e

TOXÆMIA OF PREGNANCY

DR MARK GOLDSTINE The f s t c a s e i s a oman 42 years of age in her first pre ancy wh ch as p p r o x i m a t e l y s i x a n d a h a l f m o n t h s a d a n c e d F o r t u n a t e l y t h i s o m a n w a s e a m e e d o n S a t u d a y p e i o u s t o the Monday hen he becam sick When examined she v a s a p p a r e n t l y i n g o d c n d i t o n a s f a r a s v e c o u l d d e t e r m i n e O n M o n d a y I a h e r a n d h e t o l d m e s h e v a s t a k e n l l S u n d a y a f t e r n o o n a n d o n M n d a y s h e p r e s e n t e d a t y p i c a l p i c t u r e of the toxæmia of pregnancy There v a s a g o d d e a l of d i m i n u t i o n i n t h e a m o u n t of u r i n e p a e d t h e v a s m a r k e d o e d e m a n o t o l y of the leg b u t f t h e r e t of the body she had headache m i t i n g a n d a s l o w p u l s e H e r t e m p e r a t u r e n o n a l H e r b l o o d p r e s s u r e o n M o n d a y a s a b o u t 60 She became teadily orse from day to day o t h a t i n a b o u t o d r y s a 24 h o u r s p e c m e n w a s b u t 14 u n c e s of u r i n e O e 4 h o u r p e c i m e n a s b u t 9 o u c e s S h c o n t r i n e d o f o r a b o u t 3 d a y s H e b l o o d p e s s u r e a s t h e n 20 i n t h e m o r n g a n d a f t e r n o o n S h e v a s v o m i t n g e v e r y t h i n g h e t o o k T h e a s a l a r g e a m o u n t of o e d e m a a l l o e r t h e b o d y S h e h d a p e s t e n t h e a d a c h e a n d m a l e d e v e s y m p t o n A f t e r a g o o d d e a l of d e l i c i a t o n w e d e c i d e d t o e m p t y t h e u t e u s (t h s v a s a F r i d a y O c t o b e r 4) I n t h e a f t e r n o o n of t h e t h h e b e c m e v e r y d r o y a n d s t a r t e d t o p e r p e a l t o g h h e f e l t q u i t e w e l l t h a t e n g T h t n i g h t s h e h a d a v e y g o o d n i g h t t h e b e s t n i g h t s h e h d h a d n s h e l e a m e s i c k T h e n e x t d a y s a g o d o n e s h e p e p e d f r e e l y a n d w a t e d o m e t h g t o

eat. She passed a good deal more urine so that from the 26th to the 7th we got 36 ounces of urine. There was a marked improvement in her condition from the 9th to 30th. The morning of the 26th she felt life. I could elicit heart tones in the lower quadrant of the abdomen but when I saw her that afternoon I could not get them. She continued to improve. On the 4th of November there was apparently death of the fetus and she delivered herself of a macerated fetus weighing three pounds. She made a good recovery.

In this case one of the findings was creatinin in the blood which went up to 5 per cent. According to the reports on that work under normal conditions where these patients get 5 per cent of creatinin in the blood they did not recover showing that in this case these findings did not hold good. After the death of the fetus the creatinin dropped to 3.4 per cent.

This is an interesting case of toxæmia because of the sudden onset. A remarkable improvement occurred with the death of the fetus.

Dr Goldstone reported two cases of carcinoma of the uterus and one of probable cancer of the gall bladder with ovarian metastases.

TREATMENT OF SEPTIC ABORTION

Dr EMIL RIES read a paper entitled "The Treatment of Septic Abortion" (See p. 400).

DISCUSSION

Dr RUDOLPH W. HOLMES: A paper of such fundamental importance as this should not pass without full and favorable comment. In the years that I was chairman of the Abortion Committee of the Chicago Medical Society it was my fortune to see a large number of cases of septic abortion, all due to criminal procedures. Oftentimes we had the legal responsibility placed upon the head of a physician or midwife although the responsibility rested upon him who had performed the criminal act nevertheless the death was undoubtedly due to the physician who performed the so-called life-saving operation sequential to the criminal attack. In other words death was directly due to the meddlesome midwifery of the doctor. Dr Watkins worked out this problem many years ago adopting his suggestion. I have in a great measure pursued his course which is along the essential lines of Dr Ries.

The fallacy of the opinion of those who believe in the routine curettage is evidenced by the fact that it is impossible to curette *completely* any uterus; in fact the curette rarely will cover much more than one half or at most little more than this amount of surface. At one time I believed it an essential part in the preparation for an hysterectomy to curette and then swab out with iodine. In no instance was the curettage complete and in fact no uterine cavity showed that the iodine had stained the entire mucosa. If we do a curettage we should clearly recognize it as a partial operation. As a

prophylactic measure in hemorrhage curettage has a valid place. For sepsis it does little more than stir up an inflammation.

In 1905 I brought out a small contribution on the conservative treatment of puerperal sepsis. These lines I have followed since modifying them as I felt I had developed my knowledge of the means at our disposal. They are largely along the lines described by Dr Ries.

Where it is fairly definitely proved that infection is due to the streptococcus it may be a grave menace to enter the uterus. Whatever may be in the uterine cavity is of small significance. On the other hand in a putrid infection with definite necrotic decidua or placenta retained a digital removal will prove of inestimable value. I have repeatedly seen women who have foul odorous discharges for a protracted period have an almost immediate return of normal temperature after such digital removal of the uterine contents.

Dr JOSEPH B. DE LEE: I am very glad Dr Ries again brings to our attention this very vital subject the expectant treatment of sepsis in the puerperium—the puerperium that follows both abortion and labor. This was a comparatively new thing in Chicago and even yet as we all know the expectant treatment of sepsis is not generally practiced.

I desire to take the credit for being the first in Chicago to have insisted upon the expectant treatment of puerperal sepsis. In the latter part of 1897 I read a paper before the Chicago Medical Society upon the Treatment of Puerperal Infection in which I brought out the noninterfering treatment. Naturally I was very severely criticized in the discussion. I practiced that method of treatment not as the result of any experimentation or any bacteriologic or pathologic study but simply as a matter of clinical expedience which was due to the impossibility of carrying out the established methods of treatment. I was then doing a large part of the work in the Chicago Lying In Hospital and with the fever cases that occurred it was impossible for me to give each woman a curettage and douche applications of iodine and so on that were then in vogue. Several patients had to go one to three days before I got around to give the treatment. In the meantime they got well and when I came prepared to douche to curette and sponge the patients did not need it and after a while I took courage and did not give them the treatments the books demanded and which I had been taught. After a year and a half of such experience I read this paper. Shortly after that in the year 1900 I gave up the removal of infected placenta. Up to that time I felt that one thorough cleaning out of the uterus was justifiable. I gave up the removal of the infected material in the uterus after delivery but treated abortion by the removal of the secundines. About that time my associate Dr Stowe entered the Cook County Hospital and tried to carry out the treatment I had taught him. He also tried to

are advanced as far as 4, 5, or 6 months as we see them receive entirely different treatment. If the fetus has passed and the woman has some elevation of temperature we realize that unless there is hemorrhage it is better to leave the placenta alone, not to remove it manually. I think probably all of you will agree that in these cases the best plan is the expectant treatment. But it is the early cases I see cases of 3, 4, 5 and 6 weeks duration. These cases usually come to me with hemorrhage or they are sent to the hospital with hemorrhage. I do not like to treat such cases in private houses. When a woman has hemorrhage and elevation of temperature and hemorrhage without temperature I curette and I have not had a single bad result in the last six or seven years from curettage. We have to judge from our own experience. I think careful curettage in these cases is just as good treatment because the results are just as good and although I agree it is a wise thing to print this paper in blue and red ink so that the people may awaken to a realization of the importance of the subject still I am inclined to think that the extreme statement in regard to packing is likely to inspire people with fear of proper curettage.

DR MARK GOLDSTINE. It is fortunate if one can have experience with both lines of treatment and I was fortunate that way. While I was in Dublin at the Rotunda a very active treatment of puerperal infection was carried out thoroughly.

The mortality unfortunately between the two treatments is not high enough to make the men who are radical back down but if they only had experience in both lines of treatment as to the morbidity they would soon stop radical treatment.

If I remember my statistics correctly for those patients upon whom curettage and douching were done I find the average stay in the hospital when conservative treatment was followed was 26 days while in Dublin the average stay in the hospital was many days longer. In almost every case of puerperal sepsis over there we had a pelvic abscess to open. Pyemia which is a rare condition here was a common condition over there and it was not unusual to have a patient in the hospital three or four months and when we got them through we thought it was a strong plea for our treatment.

I am conservative to the last degree. I will not go into a septic uterus under any circumstances whatsoever unless there is hemorrhage and it has to be a severe hemorrhage for me to go in. I am never afraid to let the placenta remain and I am not afraid to let the fetus remain. It is a clinical fact as Dr Ries mentioned in his paper that in septic abortion before the uterus empties itself the temperature will shoot high and after that high temperature the uterus will empty itself. I think it is criminal to go into a septic uterus unless you have great provocation to do so.

DR CHANNING W. BARRITT. I would like to say a few words on this subject. A good deal has been said in regard to priority of the conservative

line of treatment in septic abortion. I would like to claim some priority too that is the priority of always objecting to the ultraconservative form of treatment in cases of septic abortion.

If I wanted some evidence to offer here in favor of the benefits of emptying the uterus I would want nothing better than the diagrams or charts which were thrown upon the screen. Dr Ries pointed out with considerable satisfaction how the temperature dropped immediately when the uterus was emptied whether it was by manual cleaning out or whether it was spontaneous. I would say also if I had the choice with my patients or my family of having the conservative line of treatment or the very radical line of treatment I would prefer the conservative line of treatment because these women do not all die with the conservative line of treatment. They do not all die by either method of treatment but too many of them die.

Dr Holmes illustration of not being able to curette the uterus has nothing to do with the question. We are not talking about curetting the uterus but we are talking about removing foreign material from the uterus. Any line of treatment that presumes the scraping over of the whole surface in a septic condition is going to produce more damage than benefit. There is nothing that the treatment of abortion shows more definitely than that a patient is better off with the uterus emptied and that is just as true of puerperal conditions at full term only there is not so apt to be foreign material in the uterus. All who have spoken have felt satisfied after the placenta has come away. If it makes no difference whether material is left in the uterus or not why does the practitioner examine so carefully to see if there is a little material left in? The uterus does not empty itself well after abortion and it has not reached that ripe condition for emptying itself consequently there is a tendency for foreign material to be left in the uterus.

There is a line of treatment for abortion that is very safe and that is the thorough cleaning out that goes with therapeutic abortion. The patient who has a therapeutic abortion almost always does well even though she had to have the uterus emptied because of a kidney condition or because of a heart or lung condition. Such women always do well. I do not mean that they will recover from the heart condition or the kidney condition but as far as the abortion is concerned they do well. One reason for that is the complete emptying of the uterus and the other reason is that the element of sepsis has not entered there. But it is the uterus that have foreign material in them that give the mortality.

I have had some experience with the treatment of abortions. Any one who has been on the service at Cook County Hospital must have had some of these cases and the ones that come in in the worse condition are the ones that have had conservative treatment. After the removal of the placenta the temperature drops down to normal. We have had that same line of treatment in relation to the

the expectant plan of treatment. If one goes carefully over the literature of the bacteriology of septic abortion he will find that it is absolutely impossible to be guided by it. There is only one use I find and that is this: if we have one of those rare cases of diphtheritic infection of the perineum or vagina it is revealed immediately by the bacteriologic examination and we are guided as to the proper treatment. Aside from that I see no way of being guided by the bacteriologic examination.

The doctor mentioned also the question of odor with discharge and treatment by douching. One may douche if he wishes to. But if these cases that have an odor with discharge are not douched and are kept clean they get well.

Dr. De Lee wanted to know what I would do if the packing was removed whether I would dilate in every case. I dilate only those cases in which the packing has not produced sufficient dilatation. If the packing has not been carried to such an extent that the cervix admits one finger I use a few Hegar dilators.

The doctor spoke of douching for the removal of small particles. If I can leave a handful of placenta with impunity I do not care very much whether I leave small particles or not. If the uterus is cleaned out if the placenta is cleaned out the particles will come away by and by.

With reference to the remarks of Dr. Barrett in the cases he referred to the uterus was not emptied at all. It is not necessary for the uterus to be emptied for the temperature to become normal. The doctor wants to know why do we ask whether the placenta is complete after the placenta has come away. He knows why. I need not tell him but I will tell you because if the placenta is not complete we may expect the formation of placental

polypi which lead to hemorrhages. That is a question of hemorrhage not of sepsis.

Dr. Barrett brought up the question of therapeutic abortion and said the patients always do well. He answers the question himself: it is because we take such case at the time of choice when everything is all right. They are not cases of septic abortion; we have to deal with a clean field. I do not quite understand what this has to do with the question of septic abortion. I am impressed with the fact that we can cure almost any case of tumor but there is nothing in which we are so powerless as in the treatment of sepsis.

I want to say a word or two in answer to Dr. Lackner. There can be no greater difference between the two treatments carried out in the same hospital than exists between the treatment which I carry out and the treatment which has been practiced by my predecessor and as it is practiced by the gentlemen alternating on the service with me. I have read carefully Dr. Lackner's paper and he states the mortality correctly when he says it is eight tenths of one per cent. One of the cases out of the 500 having been treated expectantly. His paper does not give the morbidity. There is nothing said in the paper about pus tube, pelvic abscesses and so on.

Finally we as gynecologists who have introduced the active treatment of septic infection have to fight to get it out of the heads of the general practitioners. The general practitioners did not introduce this active method of treatment in septic abortion but gynecologists did and I think we will do well if in time we succeed in convincing at least the majority of the profession that hands off the puerperal uterus, hands off septic abortion except for hemorrhage is still the best method.

THE CHICAGO SURGICAL SOCIETY

REGULAR MEETING OF THE CHICAGO SURGICAL SOCIETY HELD MARCH 1911, WITH THE PRESIDENT DR. WM. M. HARSHY IN THE CHAIR

PRESENTATION OF A SPECIMEN OF DUODENOJEJUNAL HERNIA

DR. KENNETH HALLOCK. This is a specimen of a complete hernia of the small intestine into the duodenojejunal fossa. As to the clinical history of this case no information can be given except that the hernia was not the cause of death and was not discovered until autopsy.

The pancreas and duodenum lie to the right of the orifice of the sac in their normal location. The inferior mesenteric vein is seen passing upward to the left of the orifice and then curving to the right above the orifice. It lies within the plica venosa

The orifice of the sac lies to the left of the ascending portion of the duodenum and below the plica venosa and inferior mesenteric vein. The orifice admits the tips of three fingers easily.

Only one loop of bowel, the efferent loop, passes through the orifice. The efferent loop, which frequently happens in such hernias, has become fused with the structures of the posterior abdominal wall and enters the sac behind. The hernia is not reducible due to adhesions within the sac. However, no signs of strangulation are present.

The sac itself is directed upward and backward and lies just below the diaphragm between the peritoneum and posterior abdominal wall. The

part n m th and glen g a l t lough it
an b n th l op f l e small test e

As to the r g n of u h h r n s t d p e n l a r g e l y
u p o t h p o t i o o f t h e f r m s n t c i
Th s m a y l e n t h n l i n e f t h e f a t u s t r a l l y
I n t h s c t h e t r c t i n t t l p a n a r a l d i o l
e n u t o t h r g h t a l l f t h m e t r y t h l e f t
t h i t o l f t u r l p o l l y f t b
t a t a n l a e u s c d p l e c t n t h p l e a v e n c a
f m l This s t h e s t i g f n t o f t h e o r f i c e
o f t h a

Th c h u n s n e r y f t h e f r m t f
c h l r a a r e t h e a t n c f t h f s t h
j r e n o f t h n f e r m e n t r i c c i l f l l
l f a l l y t h m t h t y f t h e m l l l

The i z e i t h e r i s d t e r m i n e d b y t h e l v t y
o f t h e t r o p e r t n a l t s u a d t h e l s t e i l t y
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v t h n t r a u t e m e l i f e h o c r t h v u n g
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s f r t n l y l l (B o k c) A l o t n e
h a d l l r n a i t h k i n l h b n e p r t l

M o v h a n h n g r a p h m n t n l
f a e t h h r t r e p r i t e a h r i m v o c u
n t t t l e p d i d n a l f s t l m o t
i q t t f h r m H v t a t l r a t n
t t h e l l n j e j l f o a i u l k e l y n c t o
r t t i c t h e m n t v t h e t a n v r e
l m t l l r a n t g h t l y u r d l t h
j c j t c t h i g h t T h e p a r d u d e a l f a a
l l i l l t n l l m t a c t l y v t h t h e
l d j e j u a l t a o f t h a u t o r t o n a n t m y

THE METHOD OF NEW JOINT FORMATION IN ARTHIROPLASTY

D R S P H I L I S T E R A N D M I L L E R p e c t d a s u m
o f t h r e c t s i c j e m e n t l s t u d y n n j o i t
f n a t i t p 4 b

ARTIFICIAL IMI ACTION OF SUPRACONDYLOID FRACTURES OF THE HUMERUS IN CHILDREN

D R P A L I M R F S p r a c o n d y l o i d f a t i e s
f i t h m s s t h o e f u n l a t t h a t p a t f t l
l o l f t l h u e r u s h l l s s u b y e i t t
o r i g n i t h e s u p n t o r l n g u m u s c l e C h u a l l y
f u r e i t s n c t a l a y p o s s i b l e t o d i f f e n t i a t
b e t w e e n a e p a t o n o f t h e e p u p h y s i s f t h e
h u m e r u a l a f r a c t u r e j s t a b o v e t h e a t a c u l a r
s u r f a c e o f h u m e r u a d s u p r a o n d y l o i d f u
u n l e s s e o r s s h a l t t h X r a y T h e o d i a r y
c o u s e t o r d u c t h e f r t u r e a n d p u t t h e a r m
u p n t h e j o n e j o s t i o n T h s m e t h d k e p s t h e
f r a g m e n t r l a t c l g o o d p o s i t n b u t d e s n o t
a l a y a c c o m p l i s h l l t h a t s t b e d s i r e l n t h
v a y o f c u l t s T h s i m p r e s s d u p o n m e b a
c r I s s o m e t i m a g h i c h l e d m e t s e a h t r
a n o t h e r m e t h d

A l i t t l e c h i l d o e a n d a h l f y a l d a t t h e
C o u n t y H o p i t a l h a d a s u p a c o n d y l o i d f r a t t r
I t r e d c e d b y a m e m b o f t h e h u e s t a f f b u t

a f t e r l t v a s f o n d t h a t d i s l o c a t i o n o f t h e
f a g m e n t s s t i l l p e r s i s t e d I p r o c e e d e d t o r e d u c e
t h f r a g m e n t s a n d p u t t h e b o n e u p i n t h a t I t h o g h t
a s a e r v g o o d p o s i t i o n b u t a n X r a y d i s c l o e d
t h a t i t a j u t a b a d a s e r I r e f e r r e d t h e c a s e
t o D S p d a n d a f t e r h o p e a t e l o n t I o b s e r v e d
t h a t t h r e s u l t v a s o b e t t e r t h a n t h a t I h a d o b
t a i n e d

I t h e e r c o n c l u d e d t h a t t h e f r a g m e n t s h a d
l i p p e d u p o f p o s i t i o n a n d t h i s l e d m e t t r y t o
h a n d s o m e b e t t e r m e t h o d o f k e e p i n g t h e f r a g m e n t
i n p o s i t i o n W e h a v a l l u s e d t h e n a i l a n d t h e
p l a t e a n d p u t i n b o n e g r a f t m a k i n g t w o c o m p o u n d
f r a c t u r s t o h a l a s i m p l e o n e W e h e s i t a t e t o
p e r f o r m s u h o p e a t n s i n t h e n e i g h b o r h o o d o f
j o i n t s a n d c e p e r a l l y i n c h i l d r e n w h e r e a n i n j u r y
t h e e p u p h y a l l i n e m a y i n t e r f e e w i t h t h e g r o w t h
o f t h e l o e I h a p p e n e d t o r u n a c o s s s o m e w o r k
o f C o t t o n f B o s t o n o n i m p a c t i n g i n t r a c a p s l a r
f r t u r e o f t h e n e c k o f t h e f e m u a n d i t a p p e a r e d
t o m e t h a t i t m i g h t b e f e a s i b l e a f t e r r e d u c i n g t h e
f r a g m e n t s i n s u p e r n o d y l a r f r a c t u r e t o d a n
i m p a c t i o n T h e r e n o n v h y t h i s c a n n o t b e
d o n e a t t h l o e n l f t h e h u m e r s I f t h e f r g
m n t a r e e d u c e a l t h e t r a r m f l e x e d a n d a
b l o s t u c k o n t h e l e c r a n o n t h e f o r c e i l l b e
t r a n s m i t t e d t o t h e l o v e f a g m e n t A s m o s t o f
t h e e f a g n n t s s h o w m o r e o r l e s s d n t a t e i t h n e
t h e r e i l l b e l i t t l e t e n d e n c y t o d i s p l a c e m e n t a f t e r
i m p a c t i o n T h e r e n o r n t o f e t h t t h i s c a n
d o n v d a g e I n o l r t o d e m o n s t r a t t h s I
t r e d t h e p l u e i n m y n c l b b f o r e I
t r l t n a n y f t h e c h i l d n a n d t a s n o t c o o m
p a n d b y a n p u n o r d i s o m f t W e u e d a
r a d n a r y d e n m l l t o o o l p o t a t o m a h e
c o e r d v t h u c h f e l t a s t h e o r t h o p e d c s u r g o
u c i m k i n g l t e r a t s

I b e l i e t h a t a n y m t h o d f o r t h e t r a t m e n t f
f a t e c n b e j u d g e d m o r o l s b y t h e e a s e b y
h c h i t c n b e a p p l i e d W e a l l r e a l i z e t h t e
f t l e d i f f i c u l t i e s i n t h e L e p l a t e i s t h e d a n g e
o f p s s W e h a v a l l s u c c e d e d i n p u t t i n g i n t h e s e
p l a t e s a n d h a d t h e m l i d i n p l a c e a n d o c c a s i o n a l l y
s o m e o n e l s e h a s h a d t o t a k e t h e m o u t s o e r o
l a t e T h e a r t i f i c i a l i m p a c t i o n s m e t h o d t h a t
c a n b d o n e b y a n y n e e n t h e g e n e r a l p r a c t i
t i o n c r I f h e i m p a c t s t h e f r t u r e h e i l l d n o
h a m n d t h e r e s u l t i l p o s s a b l y b e g o o d T h e
o b j e c t n h a s b n a d e t h a t w e d o n o t k n o w
w h e t h e r e h a v e t h e f r a g m e n t s i n g o d p o s i t i o n
o r n o t W e h a e n a d a n e f f o r t t o c o t t o t h i s d i f
f i c u l t y b y s i g X a y s W h e t h e r w e i m p a c t r
n o t e l o n o t k n v h e t h e f r a g m e n t s a c n
g o o d p o s i t i n a f t e r e d u c t i o n I f v e f i n d t h a t
t h e n d s a r n o t i n p r f e c t a p p o t i o n t i s v e r y a s y t o
b k u p t h i m p a c t o n b e c u s e i t i s n o t e x t e n s i v e
W e v e r a b l e t o d e m o n s t r a t e t h a s s t a n t s a d
t h e c l a s a n d c l i c i t h a t a f t e r i m p a c t i n m e
m e n t s c o u l d b e c r i e d o u t a l m o s t a s w l l s b e f o r e
f r a c t u r e h a d t a k n p l a c e a n d t h t t h e r e a s n o
t e n d e n c y f o t h d i f f m t y t o e c u r S e a l h e d
t h i m p a c t i n e y p l a i n l y o n X a y p l a t s

There is one thing that I have observed in doing this work. In reducing the displaced fragments on the lower part of the arm one is inclined to think that reduction is complete when a line overlying the triceps muscle is a straight line. As a matter of fact it is not a straight line but often is a very strongly curved line. If the arm is thin the line may be nearly straight but as most of these fractures occur in children who have plump arms and they come with a great deal of swelling this line is strongly curved with the convexity backward and if we reduce simply to a straight line the reduction is not complete.

DISCUSSION

DR FRED B LUND I have been a good deal interested in Dr Cotton's work in fractures. He certainly secures very good results. However I have attributed the results more to the fact that he brings the fragments into good apposition by abduction of the thigh than to the fact that he hits the bone with a mallet. In Baltimore last fall Dr McLennan showed his results in reduction of the femur. Whitman's abduction treatment and the results were equally good. I believe that Cotton's results are due to the fact that he forces the surfaces tightly together. I think Dr More has shown us some beautifully reduced fractures and has made a demonstration of what I have firmly believed for thirty years that the fractures should be reduced by acute flexion for in that way they are forced into anatomical position. If we are sure the fragments are in good position to hit it with a mallet once or twice does no harm but I think that is not the important part of it.

DR COLEMAN G BUFORD I have the privilege of seeing a good many fractures in infants and small children and think that this particular group of fractures come to the Children's Memorial Hospital in greater numbers than any other two groups. I have been impressed with the frequency of pronounced external deformity and the actual bony deformity shown on the X ray plates. The arms are probably laid upon the plate by many X ray operators without due regard to the most correct position obtainable at that time placing the elbow on the plates in whatever position they happen to best lie thus often giving very bad looking positions.

Supracondylar fractures are among the easiest to reduce. The soft parts are not very thick in that locality and only a little extension and some manipulation at the elbow brings many of them back into position very easily. If correct position be not obtained it is because of interposition of the soft parts or some unusual obliquity or displacement of the fragments. It has been my experience that when reduction is complete and the arm is put up snugly and in the correct position the fragments do not slip out of place. Concerning the position of full flexion as a means of treating these patients I beg to differ with our distinguished visitor.

The dogmatic teaching of complete flexion as a routine in the treatment of fractures near the elbow joints is a mistake. I think that is just as big a mistake as to teach the use of vertical extension as a routine in the treatment of fractured femurs of infants. You can take the X ray plates of both classes of these fractures and pretty accurately estimate what position you must put them in to assist best in keeping the fragments in position.

Correct position gives the least callus and therefore interferes the least with future joint movement. It is the displaced fragment which is accompanied by the excessive callus. Most of these supracondylar fractures in children show backward displacement of the lower fragment. Reduce them if you will and then put them up in full forced flexion. What happens the flexed forearm carries backward the lower fragment. There is a correct angle for each of these cases surgeons must individualize.

Again and again I have treated these fractures in full extension and have only one regret. When that patient was last seen his motion was returning.

DR MORE (closing) As to whether these fractures are impacted or not I asked myself that question and think the best answer to that is that after reducing and before impacting them I tried to carry out flexion and extension and then they slipped out of place pretty easily but after impactation they did not do so. A good many of the patients were able to move their arms pretty thoroughly at the end of two or two and a half weeks and I believe that the impactation did some good. As to putting them up in acute flexion I fully agree with Dr Buford that it is not successful in all cases. Some of these I showed were not in acute flexion but most of them were.

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS IN SURGERY

IT is eci lly po H t ca l at the p lcy of
I re e gal kn t d t l lly t l om
l n d a t n d c nce of u g ry n a j u n l that
fra kly de t l f t th e t bject It is
not c ably p ble l r t fault the
c p dency f long th th g d v d ab a l e
gr v hen n u g cal j r al ha ra t t
bl c the tr il f f r h g th ough n u g cal
joy

Th ut l graphy ly t r te nt n e ery
c nt lt th p fl ng ne elf fra
g tt g ut ftl r h k n g t natu
at n c l r d h th t react e play
n d hch c tt te p l bly th gre test of
lmm t ul y y l lf ll tl d esnt pr mpt
gu h e tl t y l nscnece t add the
plct j ctu n c m n n n the dea lly formal
lp fu ct ry b k re e th t the t ok sh uld
l lly e y doct r

Of course the children will learn the
 character in the sentence the children the
 young children of school children the
 American Medical Service Life and Act American
 I led Sports Travel and Hobby — surely
 the eagle never tired enough to give the
 little red clay feet and the efficient straight
 feet the duties of the elder But
 then an autograph physical really an autograph
 noble it is the firm foundation recent
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 children

But ne f gets f rm and e ds Ge ste much a
the o l l l cr nd con i cu f ne sp h glass
topping evn a d thent n f the om m e
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ly the qu t i m Ju enal W lat do ped gr es
amount t thus len g the t ig f c o ty
i tl ut v h ch gen al leadly O el ns as
o e read that the Ge st family t ee d i n u t
t omethng a d one le ns al o from ch f elicate
t uches a the mpar n f th gr dm ther
de th to th pa ng a vay of the Venet C n r
a d f m the incompa abl pen pictu e f the f the
h r ch pter on gins m y b made to hold
inte e t

One could elect with ease to list and mention in examples of phonology that make the book unique a type of smooth ston and English pronunciation to elect enough of them to be habitually on the lips of pac

Those who are interested in pictures ignites
of the development of aspects or personalities like
Skod Rokitsansky Dumreicher Bruecke and
Myrl of the fundamental excellences and weak-
nesses in American primary and secondary educa-
tion colleges, medical schools and hospitals as
echo of the joy of out of doors of etching as an
evocation of the weather and crosses of practice
of national spirit and national consciousness and
of countless other things that are of your read this
autobiography M G S

In search of the present day literature one is often disappointed in not finding sufficient data on certain details which is essential to a perfect understanding of a subject. The important facts are labored upon but minor topics are passed over with little or no reference. This applies to a considerable extent in most present day treatises on optical technique. It is most refreshing at least to the careful reader and technician to find in Dr. Noy's work an exception to this rule. In glancing over the pages hurriedly one is not well impressed if either the opposite but a careful survey reveals a surprisingly amount of minor technical information.

Thi s ork allud d to Vol I of a system of three volum s o surgical thcr p utic aid opo t e techn que Thi s volum s d id into t o part P t on cons dcrs gncr l surg cul techn que a d p t two opo ations on thc h d In p t one th author describ s his surg cal ho ic aid methods n d tail t uls th somc degr e of ggot s n b t h n onc c n s drs th results and ork ac omplishcd by Dov n—h plac n th surg cal world espec ally n F a it con dcd n nc is only too grateful to h t It s on nan s e p r ncc and tech n qu obt d during many ycars of study and mold d by many failu s and success s It his d c d d on sultation

The subject of hemostasis treated in the most elaborate fashion giving the history and thorough consideration of the various compressive apparatuses considered applicable to the various types of internal hemorrhoids. The author has furnished a very easy to handle operation for the consideration of the standpoint of treatment before the patient and after the patient is placed in the special bed described. The technique of the anal suture and the plan

E t f f t l h E t O d b h h l l l B
W d s f D C b N l W l l m

By A. I. G. G.

tation blood transfusion surgery of the nerves the latter most carefully treatment of fistula and the treatment of cancer by electrocoagulation The treatment of carcinoma includes reference to the micrococcus neoformans the susceptibility of cancer cells to heat as a basis for his combined method of treatment viz excision and electrocoagulation and the methods for attacking cancer in the various parts of the body His apparatus is described in detail with photographs The chapters on plastic surgery are most interestingly illustrated

Part two details the operations on the head There is some repetition here from part one but it is more apparent than real The operations on the scalp skull brain ears visual apparatus nose and sinuses are included all clearly and profusely illustrated especially those on the skull and eye Many interesting details in technique are given and the treatment of unusual conditions is described

This work is so unique that it deserves a place in the library of every surgeon The author impresses one with the many necessary details of a perfect technique and unless a perfect technique is developed there is much lacking in the surgeon J A W

AS a worthy companion to the previously mentioned work appears Vol I of a treatise on regional surgery edited by Binnie One is impressed by the gradual narrowing of the scope of the new treatises This is undoubtedly brought about by the fact that many new fields have been opened in every branch of a surgical topic If each of these is given the proper amount of consideration and the whole topic is discussed the system becomes so voluminous that it loses its punch in an endless amount of detail

This treatise of which Volume I is before us will consist of three volumes Volume I is devoted to the head—branchial system thorax and the breast Volume II to the abdomen genito urinary system and the spine and Volume III to the upper and lower extremities

The subject matter of Volume I is divided into sections each of which is prepared by a man of recognized ability In the preface the author states that due to the difficulty in securing a suitable authority to write the chapter on diseases of the brain this has been entirely omitted rather than to have it a piece of hack work

All the topics are well presented and there are many original illustrations Several sections deserve especial mention The anatomy of the scalp is discussed very briefly but to the point The treatment of angioma of the scalp is elaborate The mechanism of skull fracture and cerebral compression is presented in an interesting fashion If there is one outstanding chapter in the volume it is that devoted to the branchial system The development of this system and its association with

anomalies and subsequent disease is treated most scholarly

The sections given to the tongue especially carcinoma of the tongue the accessory nasal sinuses Hodgkin's disease the thyroid parathyroids and thymus glands are complete The surgery of the breast is well written with the exception of acute inflammation and abscess which are scarcely mentioned It is quite a disappointment after reading the masterly treatise on carcinoma and cysts to have acute infections placed in a position of comparative non importance Cysts of the jaw are also very briefly mentioned—again out of proportion to the subject as presented elsewhere

The treatment of various conditions as a rule is outlined rather than given in any detail This in itself is no detriment to the work as the detail must be left to treatises on operative technique J A W

THE literature of the Mayo Clinic has again appeared in book form the present issue² containing the articles appearing during 1916 Little need be said regarding the character of these papers As usual they represent the progress of the surgical and medical profession

This volume is divided into six sections viz papers on the alimentary canal ductless glands blood head trunk and extremities technique and general It represents the literary production of 42 men during the year Many of the less frequent conditions are considered in these papers notably among which are blastomycosis of the tongue radium treatment of lymphangioma of the tongue adenoma of the palate cysts of the larynx toxic gastric hemorrhage tuberculosis and syphilis of the stomach rupture of the common bile duct diverticula of the urinary bladder and the active constituents of the thyroid

There are few men in the profession who do not appreciate the individual papers presented by this clinic The fact that this volume contains practically all the papers for 1916 neatly bound makes it doubly attractive to the busy surgeon or to the man who does not have access to a library or to various journals or cannot visit the medical centers frequently

THERE is a great tendency in medical literature to refer to a certain pathological condition by giving it the name of the man who first called the attention of the profession to it This is most confusing and leads to an endless amount of unnecessary repetition and description It is interesting to read Litcher's little volume³ and if I am not mistaken not see the word Colles Not that Colles should have less honor but that our present literature should be more accurate and descriptive from a pathological standpoint and less confusing

Ed L d b C t P H M B C L R 6 H d l p h 1
Lo d W B S 1 rs & C
B L C t L O F x T L L T H d l p h T R
J B L p l t t c 9 7

AMERICAN COLLEGE OF SURGEONS

STANDARD OF EFFICIENCY

FIRST HOSPITAL SURVEY OF THE COLLEGE

THE Regents of the American College of Surgeons herein state the factors which are the basis of the first hospital survey of the College. These factors are restricted to imperative essentials of good work. They have to do with the keeping of case records and the utilization of these records as tests of efficiency, with clinical laboratory facilities and with the character of the staff.¹

By general agreement among doctors and hospital superintendents these factors are fundamental to creditable work in a hospital. They are concerned with the kind of care the patient receives in the hospital. They do not offer a complete test of efficiency, but they draw no false lines. They are easily intelligible to laymen and to doctors. They are applicable to the small hospital and to the large one. They are tests which depend upon constant earnest effort and of sound training rather than expenditure of money. And most important they constitute a simple workable and practicable basis of standardization upon which hospitals may meet as a starting ground for further headway.

An angle of hospital standardization important to remember is this. As a people we are accustomed to hospital service we look upon that service no longer as a luxury which we may buy, but rather as an inherent right. The humblest patient is entitled to the best of medical service. In the last twenty years especially this idea has taken hold of us. We regard the right to health today much as we regard the right to life.

It follows now that in so far as the right

to health is a right of society, all hospitals in a broad sense are public service institutions. On the one hand hospitals in which sound honest care is given patients may reasonably ask the confidence, good will, and support of their communities; on the other, all hospitals are accountable to the public for their degree of success. By general consent the time has come for an accounting on both sides of the equation. Such an accounting is inevitable. If the initiative is not taken by the medical profession it will be taken by the lay public, and this entire accounting is what we mean by hospital standardization. It is an analysis of the obligation of the public to support hospitals, and it is a practical accounting to the public of the business and scientific efficiency of hospitals.

Ultimate results of hospital standardization are a matter of evolution of good will, of honesty and fearlessness in facing facts, of teamwork and of patience. Again the widely varying conditions under which hospitals operate make hard and fast standards quite impossible. But remembering these things, there is nothing insurmountable in the task.

To come now to definite criteria upon which hospitals may be justly classified. The policy of the College in its first survey, as already stated, is to define the few factors which are imperative in any hospital for the proper care of patients. Some of these factors must be conceived as flexible in order to meet fully the various conditions under which hospitals operate. But as definitely as may be the purpose of the College is to define and fully to explain the requirements and then to

¹ h p h d taff m th g p f phy sc d
p l g i t p th h p t l

AMERICAN COLLEGE OF SURGEONS

classify hospitals according to the degree to which they fulfill them. Details of this minimum standard follow.

1. CASE RECORDS

That the hospital keep in a systematic manner case records of its patients together with a convenient summary of each case and that it utilize these records in analyses of its medical and surgical efficiency.

What is meant here by case records? These records are the scientific data which pertain to each case treated in the hospital usually under the following headings when applicable: Identification of the patient by name or number; name of physician or surgeon responsible for the case; personal history of patient relevant to complaint; diagnosis on which treatment was based; laboratory and physical findings; important points of operation or of treatment; postoperative diagnosis; complication of convalescence; follow-up record; autopsy findings. Case records when properly kept provide straightforward and truthful answers to these questions: What was the matter with the patient? What did the doctor do for him? What was the result?

In Bulletin No. 1, revised February, 1918, the College has issued a set of case record forms which may serve as helpful suggestions in the matter of record keeping. Copies of this pamphlet may be had upon request.

The usual purposes assigned for the keeping of case records are: first, their value in medical science; second, their value in the practical care of patients; and third, their medico-legal value. And in addition to these purposes, the case records serve as an efficiency test in the care of patients which is most important in hospital standardization.

But in detail, how do case records serve as an efficiency test? Obviously each hospital should undertake to care only for such cases as it is justified by equipment and personnel to treat unless the circumstances of its geographic situation or other reasons make it necessary that the hospital accept all cases which seek its aid. The integrity of the profession requires that each hospital should determine whether or not its cases are success-

fully treated and if not why not; it requires that the staff by periodic review of its end results determine the types of cases which by equipment and training it is qualified to treat and that except under unusual circumstances it limit its service to such cases. Case records provide the information for these reviews. They are not therefore merely a clerical procedure; they are the very index of the success of all clinical work in the hospital.

Consistent and fearless review of case records by the hospital staff as here suggested is a just and effective means to deal with incompetent medical and surgical work in a hospital. The checking up of end results and the checking up of diagnoses before and after operation are a practical test of surgery. Facts are not debatable and facts and then more facts are needed to deal with the difficult problems of unnecessary surgical operations and of operations performed by untrained surgeons. If the facts establish evidence that a physician or surgeon is unsafe in judgment, unworthy in character, untrained, lax, lazy or careless in all honor and decency, that individual should either overcome his deficiencies or withdraw from practice. Certainly he should neither ask nor receive the privileges of practice in a hospital. In general it is the business of the staff to take the initiative in this matter. It is the professional duty of the staff to take such initiative. Without the guidance of the staff the trustees are helpless. A wise use of honest case records points the way to great advance in the medical profession.

But in many a hospital the case records although accurately kept are not available for review on the part of the staff or of the hospital administration because the significance of the records is lost in details. It is recommended therefore that important data in each case be recorded upon a summary card in order that the data may readily be reviewed. To this end the summary card (see opposite page) which for convenience should be about 5 by 8 inches is suggested.

For the details of this card and for insistence upon its value in hospital efficiency

SUMMARY CARD

Name	Address	Case No						
Physician's name	Ag	D t f dm	D t f p	D t f d	S rs	M rs	W rs	R try
Address								
Permanent friend's name	Operation or treatment important points							
Address								
Came for relief of								
	Complications of convalescence							
Dia no 1 on which treatment was based								
	Pathologic report							
Physician or surgeon responsible for treatment	Postoperative or final diagnosis							
Anæsthetic and form of anæsthesia								

the College is indebted to the Committee¹ of the Clinical Congress of Surgeons appointed by Dr Edward Martin Philadelphia. Some explanation of headings of the card is here given.

Name Address Case No Inasmuch as the summary cards are for review by the entire staff and by the hospital administration it is usually advisable not to enter the name of the patient on the card. The case number is sufficient identification.

Diagnosis on which treatment is based A physician or surgeon who treats a patient should be willing to state what pathologic condition he believes he is treating. Both the profession and the public realize that in clinical work it is often impossible to be certain that the working diagnosis is correct. With the best of equipment and of medical

knowledge diagnoses are frequently incorrect in some details but when a doctor accepts the responsibility of treatment he is in fairness to the profession and to his patient under obligation to state what he believes is the cause of the illness for which the patient seeks relief. If the cause of the illness cannot be determined the physician or surgeon responsible should at least state that fact.

Physician or surgeon responsible for treatment If one physician or surgeon only is concerned in a case it is clear that he is responsible. But in modern hospital practice it frequently happens that the responsibility is divided among many individuals. The profession has agreed however that in a properly conducted hospital either the chief of the service or one of his subordinates should hold the same position of responsibility toward the patient as does his family physician. When the responsibility is multiple

¹ The persons of this committee are Dr. A. B. Clark, Dr. W. H. J. M. Wal-
W. Ch. man, Dr. J. H. Gow, Dr. Clark, Dr. W. H. J. M. J.
J. D. Erner, A. Codman

a physician or surgeon should be assigned to the patient who sees him through the care of other specialists and the name of this physician or surgeon should be entered upon the case record

Important points of operation or of treatment Under this heading the physician or surgeon responsible should note only the essential points. He should write down the points which he may wish to know a year later if the patient returns to report his condition. If the operation or treatment is very complicated notation may be a difficult complicated operation described in detail in main record

Complications of convalescence This heading is most important for efficiency studies. If the word none follows the heading it means that there were literally no complications such as sepsis bronchitis cystitis phlebitis intercurrent infections or other conditions resulting directly from the treatment or operation or following it from other causes

Pathological report So much of the various pathologic reports as would be important for the person who examines the case a year later to know should be entered under this heading. It is not expected to be a complete statement of the pathology but merely the main pathologic diagnoses

Postoperative or final diagnosis The record here entered is quite essential to an analysis of the efficiency of the work done in the hospital. This final diagnosis should be the one used for filing or cataloguing

Follow up Notes On the reverse side of the card should be entered notes of the case made at subsequent visits of the patient or from subsequent reports as to the condition of the patient. These notes should be brief accurate and fearlessly truthful. In general the notes under the different headings should be made with the idea that they are available for rapid review. Wherever details are important and yet too extensive to be placed on the card reference should be made to the main record

In conclusion the College would emphasize the importance of adequate records. They

are in effect a pledge to the public for the integrity of all work done in the hospital. By earnest and constant attention to case records it often happens that an isolated and poorly equipped hospital makes up for its material deficiencies first because its staff is inspired always to its highest attainments second because by honest selection of its cases it will not undertake the treatment of cases for which it is not equipped. It follows therefore that such a hospital may be rated higher than a large hospital with modern equipment and scientific reputation

2 CLINICAL LABORATORIES

That as implied in the foregoing requirement concerning case records the hospital provide either directly or indirectly the laboratory facilities which in the science of medicine are essential in the diagnoses and treatment of patients admitted for care under normal conditions

While for economic reasons and expediency it is usually advisable that the clinical laboratories be owned and operated by the hospital neither ownership nor control of the laboratories is essential. In many instances state county municipal or private laboratories supplement to advantage the laboratory facilities of the hospital

Because of the wide discrepancy in the range of diseases and illness treated by hospitals it is not feasible to stipulate minimum laboratory facilities. Efficient laboratory service is here emphasized rather than details of equipment. The laboratory requirement is therefore that the hospital have the constant use of clinical laboratory facilities adequate in the scientific diagnoses and treatment of its patients. The extent of the laboratory facilities with which a hospital should provide itself depends upon the types of cases normally admitted for treatment. In a general hospital the clinical laboratories under a practical laboratory worker will provide when adequately equipped chemical and microscopical examinations including blood examinations gastric contents sputum examinations urine analyses faeces examinations and examinations of cerebro spinal fluid bacteriological examinations patho-

logical and serological examinations electrocardiographic examinations and X ray examinations The laboratories should include also a postmortem room instruments for the performance of autopsies and facilities for the preparation of frozen sections

3 DIVISION OF FEES

That the hospital trustees or governing authority in co operation with the staff take action definitely to prohibit from all services of the hospital the practice of division of fees

The evil of the division of fees is so widely recognized that emphasis of it here is not needed The practice is prohibited by law in Kansas Nebraska Iowa Minnesota Wisconsin Ohio Alabama West Virginia Tennessee and Colorado Where it exists under any guise whatever it is in reality the buying and selling of people who are ill The consequences of the division of fees are first incompetent medical and surgical service second unnecessary surgical operations and third the deadening of scientific incentive in the profession and the lowering of the whole profession of medicine into dishonesty The fact is unchallenged that no intelligent community would tolerate this practice in its midst if the community were aware of the practice and of its significance

A secret profit made upon the sale of eye glasses or of appliances is considered division of fees

The College requests each hospital to meet this issue squarely It asks that by resolution the trustees or governing authority of the hospital in cooperation with the staff of the hospital go on record substantially as follows

Be it resolved First that physicians and surgeons who may have the privileges of practice in (name of hospital) shall not engage in division of fees under any guise whatever while they avail themselves of these privileges

Second that physicians and surgeons privileged to practice in the aforesaid hospital shall by the acceptance of these privileges thereby pledge themselves to the following principle

I hereby agree that as a principle I shall not engage in the division of fees under any guise whatever By this principle I understand that I am not to collect fees for others referring patients to me nor to permit others to collect fees for me nor to make joint fees with physicians or surgeons referring patients to me for operations or consultation nor knowingly to permit any agent or associate of mine so to do

Third that a copy of this resolution shall be conveyed to each physician and surgeon privileged to practice in the aforesaid hospital

In a large number of hospitals the practice of the division of fees has never existed and sometimes the staffs of these hospitals are sensitive with regard to passing a resolution as stated above The Regents of the College believe however that these hospitals will after due consideration gladly take action as recommended because of the influence which they will have by such action upon hospitals where the practice does exist

IN THE WAY OF PROGRESS

Neither the hospitals nor the College would ultimately be content with standardization which takes into account only the foregoing minimum standard Having made a beginning of standardization and agreed upon a common meeting ground as stated in the foregoing pages other important factors of hospital work call for attention The College respectfully asks that hospital staffs from time to time consider the various problems which in their judgment should become part of the standardization program and that they send to the College both suggestions and reports of progress Some of the phases of

hospital work which were considered of prime importance by the General Hospital Committee are here stated —

THE TRAINING OF INTERNES The training of internes affects directly a comparatively small percentage of the hospitals In a larger sense however it affects all hospitals and in fact all of the people of the continent for it has to do more than is generally realized with the making of competent physicians and surgeons Dr Edward Martin for instance estimates that a doctor on graduation from medical school is only twenty per cent efficient as a practitioner of medicine and

that service as an interne under right conditions may provide nearly eighty per cent of the training of a doctor. Dr. Allen B. Kanavel writes: "The medical school sends the student from its doors with a diploma asserting that he is qualified to practice medicine, a polite fiction that we have accepted while at the same time belying our acceptance by insisting that the student should serve an internship."

In Pennsylvania and in Minnesota today the medical graduate is required to serve an internship of one year before he is licensed to practice. In Pennsylvania the Bureau of Medical Education and Licensure inspects hospitals with special reference to the training of internes; further it states in what hospitals service as an interne is acceptable in partial fulfillment of the requirements for practice in that state. The leadership in this matter taken by Pennsylvania will undoubtedly be followed by other states.

The staff of each hospital where internes are engaged may well consider the following questions: Do internes receive training in the writing of case records? Do chiefs of departments give instruction to internes at the bedside of patients and throughout the procedure of each case as to the salient points of record keeping? Are internes under competent guidance trained in the clinical laboratory? Do they follow clinical cases to the laboratory? Do they receive systematic training in the making of postmortem examinations and in the preparation of sections of tissue from postmortems for microscopical examinations? Are they permitted to do independent major surgery or to take full charge of obstetrical cases in the first year of apprenticeship? Do the influences of the hospital make for high ideals of practice? Do they create the right start for a busy, happy and useful professional career?

THE TRAINING OF NURSES The training of nurses came into existence in hundreds of hospitals as a matter of expediency and it is only in recent years that this subject has been given due consideration. The trained nurse is an indispensable aid in the care of patients. She is also a power in preventive medicine. In fairness now to the nurses them-

selves and to the patients whom they are to serve comes the question as to whether the three years required in the training school are really three years of educational training? Is a sound curriculum provided for the instruction of nurses? Is the teaching under competent supervision? Are pupil nurses sent out into families? If so in what year? Are pupil nurses placed on special cases in the hospital? If so in what year? Are fees received by the hospital for special duty of pupil nurses? Is the practice medically and educationally justified? The training of the nurse should be given the same thoughtful attention as that given to the interne.

POSTMORTEM EXAMINATIONS The keeping of case records implies that postmortem examinations are made whenever consent for such examinations can be obtained. The value of these examinations is here specially emphasized. The postmortem is a merciless criticism of the work of physicians and of surgeons. It is the sort of criticism however which physicians and surgeons who are guided by a scientific spirit welcome. There is probably no phase of hospital work which will so definitely put an end to incompetent and unnecessary surgery and to careless and indifferent diagnoses in medical cases as will a consistent policy of postmortem examinations with staff review of the findings. Further these examinations if their results are regularly and fearlessly reviewed by the staff will serve as a stimulus to scientific work and to valuable investigations. Again they justify the effort which they cost a thousandfold in their practical value to the immediate relatives of the deceased.

Each hospital staff should ask itself from time to time as to whether or not its percentage of postmortem examinations is as large as could reasonably be expected. Are the complete autopsy reports filed with the respective case records? Does the pathologist meet with the staff to review the clinical histories in relation to autopsy findings? Are the immediate relatives of the deceased informed fully as to the probable value to them of the postmortem examinations?

OBSTETRICS More credit than has yet been recognized is due to Dr. J. M. Baldy

president of the Bureau of Medical Education and Licensure of Pennsylvania for his insistence that the hospitals of Pennsylvania provide obstetrical departments. Dr Baldy has also done much to educate the people of Pennsylvania as to the value of hospital obstetrical departments. This whole problem touches in a vital way the conservation of the life of the nation. It means the saving of thousands of babies which unnecessarily die in the first few weeks or months of life. In the next ten years it is reasonably certain that great advancement will be made in obstetrical services. Certainly this whole problem is one which should receive the most earnest consideration of each hospital staff.

If a hospital today does not provide for an obstetrical service for what reasons is this service neglected? If an obstetrical department is provided does it include a special delivery room? Does it include a nursery? Is prenatal work conducted in the department in the out patient department? Do nurses in the obstetrical department come into contact with patients of other departments?

PEDIATRICS Closely allied to an obstetrical service is work in pediatrics. The initiative taken recently by various state legislatures providing for the care especially of crippled children is indicative of a general awakening of the people to the value of departments of pediatrics in hospitals. Ob-

viously a hospital should not create such a department unless it is in position to have a trained pediatrician in charge. But if such a department is provided then some important questions which arise are: Is a receiving and observation ward provided? Is an isolation room provided? Are throat vaginal smears and other examinations as to infections made of all children before admission? Do nurses of this department come into contact with patients of other departments?

CROSS INFECTIONS Does the hospital take all reasonable precautions against cross infection? Are examinations of patients on admission especially of children adequate in this respect? Are clean and septic operations conducted in the same operating room? Is the sterilization employed in and about the operating room effective? Is infection possible through the laundry or kitchen? Is constant check kept upon these matters? Are sufficient precautions taken with regard to the passing of nurses from one department into another who may carry infection?

Dietetics anesthesia accurate and intelligible financial accounting hospital administration the pharmacy and supervision of prescriptions and the library and encouragement of research are among other important subjects which merit consideration.

For the Board of Regents of the American College of Surgeons

JOHN G. BOWMAN *Director*



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THE MANAGEMENT OF RENAL TUBERCULOSIS¹

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NO more distressing condition is encountered in the realm of urology than that of renal tuberculosis in its origin and early development how often this disease is allowed to go on unrecognized with its remissions and reappearances until enough of the urinary tract has become involved to render a cure an impossibility. Only through the more careful study and analysis of urinary symptoms have we been able to demonstrate the frequent occurrence of this disease to follow its progress and to outline a method of treatment in each individual case.

To form the basis for certain remarks which I wish to make with regard to the diagnosis, pathology and treatment of renal tuberculosis I have selected five from a series of cases operated upon by me which demonstrate the different types most frequently encountered.

CASE I. Male, age 34. For eight years had the patient suffered from frequent burning urination and pain in the perineum at the end of urination. The symptoms were intermittent for five years when remissions became less frequent. For the past three years the symptoms have been continuous and the patient has lost weight and strength. In 1913 he began to void every half hour with intense tenesmus. The urine was loaded with pus, there was some blood and many tubercle bacilli. The bladder was contracted, retaining but one ounce of fluid; the mucous membrane was edematous, especially about the left ureteral orifice which

was enlarged, rigid (golf holed) and contained tubercles.

Urine from the left kidney contained pus, blood, tubercle bacilli and showed a low urea output. Urine from the right kidney contained no blood, pus or tubercle bacilli.

The left kidney on removal (Plate I) showed almost entire destruction of the parenchyma with abscess pockets, some of which contained a thick, putty-like substance, others a thin fluid.

Nephrectomy was done in 1913 and was followed by bladder symptoms for one year with slow abatement. Two years later the patient was free from symptoms.

CASE 2. Male, age 23. Three years ago the patient first noticed frequency of urination which lasted one month followed by remission for 4 months. This attack was relieved but recurrences appeared from time to time. The last attack continued for three months. There were occasional attacks of pain in left lumbar region followed by the passage of cloudy urine. The bladder appeared normal. Urine from left kidney was pale, it had a low specific gravity, low urea, contained few pus cells and no bacteria. Urine from the right kidney was normal.

Following ureteral catheterization the patient passed a small phosphatic calculus with an attack of renal colic. The urinary symptoms recurred in two months. Ureteral catheterization revealed a few isolated tubercle bacilli in the urine from the left kidney.

The patient was given tonic treatment and urinary antiseptics for four months with improvement of local symptoms and general health.

Nephrectomy in 1915 revealed a kidney, the upper pole of which (Plate II) was entirely destroyed, walled off and contained no active tuberculous foci. The patient was out of the hospital in ten days and has been perfectly well to date.

Presented before the 1st Annual Meeting of the American Association of Genito-Urinary Surgeons, New York, N. Y., 1917.

CASE 3 Female age 31 The symptoms ere sudden in onset and lasted four months They started ith frequency urgency tenesmus pain at the end of u nation and hamaturia These symptoms ere continuous

The bladder mucous membrane bowed into ec congestion and edema about the left ureteral orifice Urine from the left kidney as twice the amount from the right alkaline pale contained pus blood and many tubercle bacilli Urine from right kidney was normal The lower end of the left ureter was palpable through the vaginal vault thickened and tender

Nephrectomy on 4 revealed a kidney of normal size with several small ulcerations at the angle between the papilla and calyx (Plate III) Bladder symptom were relieved in three weeks Recession a complete

CASE 4 Male age Extreme kyphosis and lordosis from spinal tuberculosis were present The tubercular lesions as apparently healed for six years One month ago there as sudden onset of frequent painful urination and hamaturia

The bladder mucous membrane as deeply congested about the left ureteral orifice The urine from this kidney was abundant cloudy from blood and pus contained no malum output and numerous tubercle bacilli Urine from the right kidney was normal

Nephrectomy twenty months ago was accomplished with some difficulty owing to the extreme deformity of the chest and abdomen A small kidney of healthy appearance was removed which when sectioned (Plate IV) showed two small ulcerations at the angle between the papilla and calyx Four months after the operation in this case an epididymitis developed which went on to suppuration discharging on the surface Bladder symptoms were relieved immediately following the removal of the kidney The patient is well today

CASE 5 Male age 26 Six years ago the patient developed a pulmonary lesion 5 months later without urinary symptoms tubercle bacilli were found in the urine in the course of a complete physical examination

Examination of the bladder showed a normal mucous membrane and ureteral orifice Urine from the left kidney as double the amount from the right pale contained albumin pus blood cells tubercle bacilli and a low albumin output Urine from the right kidney was normal

The patient was treated by the open air method until 1917 Repeated cystoscopic examinations and ureteral catheterizations revealed only a deficient left kidney function No tubercle bacilli were found For past two years patient has had repeated attacks of dull pain in left costovertebral angle accompanied by gastro intestinal symptoms which lasted two or three days and which were relieved by a clearing out of the bowels

Nephrectomy three months ago revealed a moderately enlarged kidney which on section

showed numerous walled off pockets (Plate V) containing a thin serous fluid The patient is now living in the open and well

The kidney removed in each of these cases showed the types of lesions encountered in true parenchymatous tuberculosis with extensive destruction of renal tissue as in Cases 1 2 and 5 and apical tuberculosis or tuberculous pyelitis as in Cases 3 and 4

A knowledge of the pathology of renal tuberculosis is necessary to understand the clinical course of the disease and the proper management of the case

Observations by Buerger (1) Keyes (2) Eisendrath (3) Braasch (4) Cabot (5) and others verify the fact that the tubercle bacilli gain access to the tissues by a process of filtration from the blood into the parenchyma and urinary tubules and instead of being excreted are arrested and the various pathological changes such as infiltration caseation etc begin The bacilli usually lodge in the parenchyma so that one sees cases in the early stage where the chief focus in which the typical infiltration and formation of cavities is seen is associated with more or less nodular involvement of the entire parenchyma or the bacilli may reach the surface of the papilla or calyx recess where they are amassed in sufficient numbers to bring about a tuberculous lesion

As pointed out by Buerger (1) the angle between the papilla and calyx may afford a favorable nidus for the accumulation of bacteria the anatomical disposition of the parts allowing poor drainage This may result in ulceration as in Cases 3 and 4

As the infection spreads more and more of the parenchyma undergoes changes typical of tuberculosis in other tissues i.e. the formation of either granulation tissue or of miliary tubercles with subsequent caseation and the formation of larger or smaller cavities In the early cases the cavities are filled with the typical cheesy debris the result of the destruction of the kidney parenchyma each cavity being limited by a capsule In older cases the entire kidney is converted into a series of cavities each containing a putty like substance the result of further changes in the caseous detritus Not infrequently phos

phatic deposits form on the walls of these cavities. The infection may remain limited to the kidney itself or spread rapidly toward the capsule later involving the tissues around the kidney forming a perinephritic abscess or a fistulous tract which may open anywhere in the vicinity of the kidney.

If allowed to progress an extension of the tuberculosis to all layers of the pelvis to the ureters and to the bladder takes place upon the mucous surface of which tubercles form and ulcerate while externally the process excites a peri ureteritis with irregular thickening of the ureteral wall. As a result of this ulceration and infiltration stricture formation takes place in the ureter.

Braasch (4) has emphasized in connection with the pathology of tuberculosis of the kidney the determining influence of strictures of the ureter their situation number and character. Thus if the first stricture lies near the bladder a varying dilatation of the ureter above it and of the renal pelvis will necessarily follow depending on the degree of the constriction. If the first stricture is in the upper ureter there may be multiple strictures below it. If the ureter becomes closed early a large pyonephrosis may result if later a caseated remnant of the kidney may remain.

Depending upon the general condition of the patient a real effort is made to wall off the kidney process leading toward a spontaneous cure. This effort was shown in Case 1 and was accomplished as far as any active process was concerned in Cases 2 and 5.

The symptoms of renal tuberculosis are almost entirely urinary and are due to active pelvic ureteral and vesical lesions originating in ulceration of the primary renal focus into the renal calyx or pelvis with the resultant discharge of tubercle bacilli into the urinary stream. The mere presence of a tuberculous lesion in the renal parenchyma causes no symptoms.

Frequent painful urination is most often the first symptom and is usually present so long as drainage of the renal focus is maintained. It is to be borne in mind however that frequency may be due to toxic nephritis on one side resulting from the absorption of poisons from the tuberculous kidney on the

other side. In Case 5 there were no urinary symptoms.

The intermittent character of the urinary symptoms is thus seen to be due to the drainage of one cavity followed by the absence of bacilli in the urine the healing of secondary pelvic and vesical lesions and their recurrence when a second pocket breaks through re-infecting pelvis ureter and bladder. This was noted in three of the cases.

Renal colic may result from the passing of blood clots cheesy debris or phosphatic deposits as in the second case. Autonephrectomy may occur from slow ureteral occlusion.

When the lesion is apical the ulcerated area being close to the pelvis or calyx remains open and the urinary symptoms are sudden in onset severe and apt to be ushered in with hæmaturia as in Cases 3 and 4.

Pain in the loin may result from renal colic renal distention perinephritis or dragging on a shortened and thickened ureter.

The general health of the individual usually shows progressive impairment but remarkably good health may be maintained. Even when the active process has become arrested as in Cases 2 and 5 the poor drainage of the cavities left by the kidney destruction will result in a mild periodic general toxæmia from absorption of retained secretion as in Case 5.

Enlargement of the kidney may be appreciable and tenderness may be noted especially in the costovertebral angle.

From the foregoing pathological and symptomatological considerations the importance as well as the difficulty of diagnosis of renal tuberculosis can be appreciated. Its presence should be suspected in any long continued history of frequent painful urination. With the perfection of cystoscopic technique it would seem that the diagnosis should be comparatively simple but the intermittency of the drainage the character of the pathological lesions present when drainage of the kidney focus is maintained i.e. a highly irritable bladder which is distended with difficulty œdema of the mucous membrane which often obscures the ureteral orifice or bladder lesions resulting in distortion and finally ureteral stricture interfering with

catheterization make the cystoscopic manipulation the most difficult of all conditions encountered and often result in success only after time and extreme patience have been employed.

I am convinced that a positive diagnosis may be made in every case if one is willing to take the necessary time and care. The writer has seen the most unfortunate results from hasty diagnosis and proceeding with incomplete data. Repeated ureteral catheterization and pyelogram may be necessary for a diagnosis in cases showing long remissions. Rest and internal medication should be given for a considerable period of time in order to allay the acute inflammation sufficiently to make the instrumentation possible in those cases presenting severe symptoms.

By diagnosis I mean the detection of renal tuberculosis, its localization and estimation of the separate kidney function. Physical examination is often of little value in making a diagnosis of renal tuberculosis. The lower end of a thickened tender ureter may be palpated per rectum and almost always through the vaginal vault. This examination should always be made. Cutting down on both kidneys and direct examination of each kidney may be necessary and is advisable if other means fail. A case seen by the writer in which ureteral catheterization was impossible owing to an obstruction in the lower end of each ureter due to a crossing of the ureters after leaving the bladder (the left ureter going to the right kidney and *vice versa*) in whom the better of the two kidneys was removed might have been saved had this been done.

For more than thirty years after the recognition of tuberculosis of the kidney by Fayr in 1841 the treatment of this affliction was confined to the domain of internal medicine. When Peters (6) in 1872 first performed nephrectomy in a case of tuberculosis of the kidney the operation was a very rare one for any condition as may be judged from the title of his article reporting the case. Quoting from the autopsy report Peters says:

This condition is described by most writers as primary infiltrated tuberculosis of the genito-urinary organs. Despite the fatal outcome of this case the treatment of tuber-

culosis of the kidney was gradually shifted from the field of medicine into that of surgery. So extensive had this change become in the next twenty years that nephrectomy for tuberculosis of the kidney was pronounced an error of the times (7). Men have been found it was stated who would perform this operation.

Such warnings from the more conservative element of the medical profession did not serve to check the swinging of the pendulum in the direction of the surgical management of tuberculosis of the kidney as may be judged from a partial review of the periodical literature for the past five years.

The status of the medical treatment of renal tuberculosis for the five years following the International Urological Congress held in Paris in 1908 was reviewed in 1913 (8) when the animated controversy regarding the mode of management of these cases was at its height. The results with the various non-surgical methods mentioned in this review (dietetic and hygienic measures, radiotherapy, heliotherapy, tuberculin treatment, treatment with the immunity bodies of Spen-gler, etc.) have not served it will be seen materially to alter the view that nephrectomy the sooner the better is the method of choice in the presence of unilateral renal tuberculosis. For as this reviewer states, operating surgeons led by Albarran and Israel are unanimous in demanding under such circumstances the early performance of nephrectomy.

Thus we find Morson (9) teaching his students at Middlesex Hospital 1912 that the watch and wait treatment which is advocated by some surgeons only spells disaster and misery to the unfortunate patient. In bilateral renal tuberculosis and in cases in which the disease is present elsewhere he recommended conservative treatment, nephrectomy being confined to cases in which the disease is located in one kidney.

In this connection too careful a study of the tuberculous patient cannot be made. Whether tuberculosis of the kidney is a primary lesion is still a question and a thorough search should be made for active or latent foci in other parts of the body.



Plate III Tuberculous pyelitis

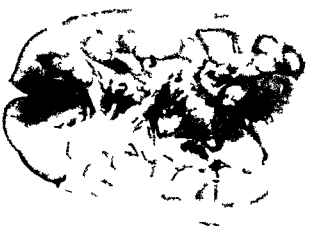


Plate IV Tuberculous pyelitis



Plate V Parenchymatous tuberculous nodules

(The Management of Renal Tuberculosis — H. G. B. Gb.)

The recognition of such foci is most important in outlining a plan of treatment for renal tuberculosis. I have seen a general military tuberculosis light up after nephrectomy in three cases and latent foci appear in the lungs, lymph nodes and epididymis in many others.

This leads the writer to advise the placing of the patient in the best possible condition before operation by rest, nourishing diet, tonics, increasing elimination, the administration of a non-irritating urinary antiseptic, the adoption of an operative technique by which the kidney is removed as rapidly and with as little traumatism as possible, the destruction of foci in the ureter by injecting pure carbolic acid, anchoring the ureter in the lower angle of the wound, closure of the wound, and again treating the patient for a prolonged period as a case of pulmonary tuberculosis would be treated.

If this procedure is followed the patient will come to operation with more bodily resistance, the operation will take less of his vitality, and dissemination of the disease following operation will be less likely to take place. This point is well demonstrated by the second and fifth cases reported. The active disease was arrested in these cases, and the nephrectomy was attended by no more reaction than would have accompanied the removal of a cyst.

In inoperable bilateral renal tuberculosis it is surprising to see how much may be accomplished by general hygienic treatment. A most striking case of this class was seen by the writer six years ago. The patient, a man of 28, presented an advanced tuberculosis of both kidneys and bladder with extensive destruction of kidney tissue as shown by functional tests. His symptoms were most distressing. The passage every fifteen minutes of thick, bloody urine was accompanied by great tenesmus. His general condition was bad. He was sent to the mountains to be treated as a case of general tuberculosis and given santalol to relieve his urinary distress. The patient is now alive in very fair general health, his urinary symptoms are slight, retention of urine for three or four hours is often possible, and he is able

to follow his profession which fortunately is that of a writer requiring no physical exertion.

The tuberculous patient is to be regarded as one who must use every atom of his physical force to limit the activity of the tubercle bacilli. Anything which uses up this fighting force, be it due to the activity on the part of the patient or to the reaction resulting from treatment, must have a deleterious effect. This must be continuously borne in mind in preparing patients for operation in following them after operation, and in treating inoperable cases. The writer is convinced that many cases of tuberculosis of the lower urinary tract, epididymitis, prostaticitis and vesiculitis appearing after nephrectomy could have been prevented had this fact been borne in mind.

In this connection a note should be made with regard to the administration of tuberculin. Much has been said for and against its use, lately mostly against it. It seems to me that tuberculin is often beneficial if given in such small doses so slowly increased that a reaction is obtained which is not sufficiently pronounced to lower the patient's resistance. So often the efforts of nature are not properly graced, and in attempting to hasten the progress the feeble but constantly increasing assistance is lost, and the treatment is condemned and cast aside.

Bernard and Heitz Boyer (10) upon the basis of their findings maintain that with the exception of those cases in which nephrectomy is not possible, the treatment of renal tuberculosis consists in the removal of the diseased kidney as soon as the diagnosis is established. In cases of uncomplicated unilateral renal tuberculosis they hold that nephrectomy is indicated not only as a last resort but as an early and adequate measure. Nephrectomy alone can cure the patient completely and reliably. Its early performance increases the prospects of obtaining such a cure, protecting the patient against vesical complications, recurrence in the other kidney, tuberculous generalization, etc., more effectually than when it is done late or omitted altogether. Tuberculin treatment, in the opinion of these authors, has no place in the

treatment of unilateral renal tuberculosis not even after nephrectomy

Parkinson (11) in presenting a case before the Royal Society of Medicine 1913 expressed himself as inclined not to operate inasmuch as the kidney had shrunk so much under medical treatment and the patient a boy of eight years had gained in weight. He asked for an expression of opinion from those present and was advised to operate. One member suggesting preliminary treatment with tuberculin.

Braasch (4) summarizing the results of operation in 203 cases of renal tuberculosis says

51 (25 per cent) of the 203 patients operated on died in the hospital. Excluding the cases of those patients operated on during the past year as being too recent to be of statistical value we are able to obtain the subsequent history of but 150 per cent of the patients. Of this number 18 per cent were reported dead. Of this 8 per cent 6 per cent died during the first year after operation and 15 per cent died more than three years. Of the 8 per cent live all but 3 per cent reported improvement on record from their previous bladder symptoms. The majority of these reporting no bladder improvement had gained in weight and strength.

The length of time elapsing before the bladder symptoms were relieved varied from a few weeks to five years after operation. 6 per cent in less than a year. Seventy-five per cent of those patients reporting improvement in their bladder symptoms gave a history of bladder infection of more than five years standing. The operative wound was reported healed in less than three months by 43 per cent of the patients and in less than a year by 87 per cent. The number stood as long as four years in one case. Uretectomy may not seem to affect the after course materially. In the fourteen patients in whom ureterectomy was done with the nephrectomy the sinus persisted fully as long as in the others.

Of fifty patients in whom the diagnosis of bilateral tuberculosis was made and substantiated on exploratory and in whom the more diseased kidney was removed all were reported dead within a year after operation. While our results in operating for bilateral tuberculosis are not so satisfactory as those noted by some observers the operation may occasionally be followed by cure.

Operative mortality is therefore a negligible factor in nephrectomy for renal tuberculosis. We can expect a permanent cure in fully 5 per cent of patients operated on. On the other hand if either be treated fully 10 per cent must eventually succumb to the infection and striking the small

chance for such a cure the risk of infecting the bladder in other foci is greatly increased.

Braasch (12) in another communication of the same year gives the following reasons for delay in seeking surgical relief for renal tuberculosis

(1) The true nature of the disease still too frequently remains unrecognized by the general practitioner. (2) It is not generally known that surgery is the best means to cure tuberculosis of the urogenital tract. (3) There exists a widespread belief that renal tuberculosis can frequently be cured by means other than surgery particularly through the use of tuberculin. While it may be true that incipient renal tuberculosis may occasionally recover spontaneously, it has been our experience that in such a case so exceptional that it must not be relied upon.

Of 8, cases (up to January 1, 1912) diagnosed as renal tuberculosis Braasch continues

Two hundred and twelve patients have been operated upon leaving however not operated upon. Of those not operated upon we were able to trace 48. Ten patients were reported alive 2 between five and ten years 4 more than one year. Of this number 8 have been found but 3 in whom the tubercle bacillus has disappeared from the urine and in whom the vesical symptoms have ceased. Two of the 8 cases are of less than five years duration and the third is of eight years duration. It is of interest to note that the three patients were young adults less than twenty years of age.

In whom the progress of the disease usually more rapid than in patients above forty. The three left then 38 patients who are known to have died or a non-operative mortality of 80 per cent. Of those registered a non-operative our records show 6 patients in whom both kidneys were infected. Twenty of these gave a distinct history of infection in the second kidney from two to ten years after the first kidney became diseased. Although we advised twelve of the latter to try tuberculin all with one exception have needed

Rovsing (13) expresses the following very positive opinion regarding the treatment of this disease

In recent years the concept of the prognosis has become a pessimistic one. The renal tuberculosis is now considered a fatal disease of kidney tuberculosis is thought to be treatable only—by detritus measures and the tuberculin—while nephrectomy should be indicated only in advanced unilateral cases.

In my opinion this doctrine is so good and erythrogenic tuberculin is so effective in either the case of early or advanced unilateral disease

Behind the lightest and veiled symptoms the most advanced the most malignant tuberculo is may be hid — recently proved by some of my cases. Second there exist no convincing case of tuberculo is kidney cured by conservative treatment. As now the statistics have established that we by nephrectomy can save 5 per cent of all patient operated on it seems quite clear that nephrectomy is indicated as soon as we have diagnosed unilateral kidney tuberculo is. In pending the time on conservative treatment you run the risk of proceeding the tuberculo is to the bladder and to the other kidney and thereby destroy the possibility of a radical cure.

Etendrath (3) from a study of nearly fifteen hundred cases operated on including a number of his own concludes that in unilateral renal tuberculo is the operative mortality in the early months of the disease is only a little over 2 per cent and that the late or remote mortality (first five years) is not much higher. Even in the latter he holds the mortality is far less than it would have been if the condition had remained unrecognized or not subjected to operation. He further concludes that no authentic case of tuberculo is of the kidney exists which has recovered under similar i.e. non operative treatment without complete loss of function of the kidney.

Kaplan (14) in an extensive discussion of renal tuberculo is from various points of view makes the statement

"The only factor is the only rational treatment to be considered is the preservation of the kidney. We know today that in primary tuberculo is of the kidney which as a rule is unilateral a nephrectomy brings about a disease cure as long as the other kidney is healthy. We also know that when lesion occur in the other kidney an operation on the diseased kidney is not a definite result as for a cure is considered but we do not know under what conditions lesion in the other kidney remain in abeyance. The case it follows that when a diagnosis of the existence of a tuberculo is of the kidney on one side has been established that fact forms an indication for an operation and the removal of the diseased kidney."

Keele in discussing two cases which had remained entirely without symptoms for two and six years respectively at the end of his period the symptom returned and nephrectomy was performed with success. As

we look at these two specimens I think we may anticipate the day when specimen similar to these shall be made the basis of a plausible but entirely unwarrantable pathological attack upon nephrectomy for the cure of renal tuberculo is.

Renton (15) in giving some case reports with comment adds his opinion to the list of those who hold that if one is sure the disease is renal that it is unilateral and that the other kidney is healthy nephrectomy the earlier the better is indicated.

Cabot (5) introducing a study of end results made by Crabtree says

The tendency to watchful waiting which was generally but another name for medical procrastination has considerably abated and there is practically no difference of opinion among those qualified to express one that in unilateral renal tuberculo is operation offers the only chance of cure and the so-called medical treatment only prolongs the agony. The scientific world is waiting for proved cases of renal tuberculo is healed permanently except by removal of the kidney either by nature or by art.

Kilbane (16) states unequivocally that nephrectomy is the logical treatment for uncomplicated unilateral cases as soon as a diagnosis is possible.

Cabot and Crabtree (17) in another study of renal tuberculo is among other renal infections state that cure results only by removal of the whole kidney either by nature (caseation) or by art (nephrectomy). They purposely omit a consideration of the treatment of renal tuberculo is because it consists wholly in the removal of the kidney when the diagnosis has been made.

Dock (18) closes his contribution to a symposium on tuberculo is of the kidney with the laconic statement "Extirpation of the affected kidney is at present conservative treatment." His views concerning the possibility of spontaneous healing in this disease will be discussed later.

From the foregoing opinion, elected from the writings of a representative list of surgeons and urologists, it may be judged that the observer quoted advocate the taking of no chances on the basis of the possibility of the spontaneous healing of the tuberculous kidney and little more on the

ground of possible improvement under non surgical treatment

Heitz Boyer (19) for example warns against accepting the so called spontaneous cure of a tuberculous kidney—which consists in an exclusion of the diseased kidney—as a curative process in the true sense of the term. A tuberculous focus cannot remain in the body for years without causing harm. Aside from the fact that the process of seclusion itself favors the lodging of tubercle bacilli in the other kidney, an important pathological part is played by the stenosis of the efferent urinary passages which precedes the exclusion of the kidney and results in stagnation.

There are also, this observer states, in which absolutely clear urine is secreted by means of ureteral catheterization from a kidney known to have been positively tuberculous in the past. Such cases serve as an argument in favor of the view that internal treatment, i.e. specific treatment, is capable of curing renal tuberculosis with preservation of the renal function. These cases, he points out, are very exceptional, however. Among 150 cases collected in a circular inquiry, together with Bernard Heitz Boyer found only one case in which clear urine was voided from a previously tuberculous kidney after its treatment with tuberculin. Similar observations have been made by other investigators. According to the findings of Heitz Boyer, in anatomical preparations these cases do not represent a cure of the diseased portions, but a seclusion of these from the remaining healthy part of the kidney parenchyma. The rarest of all communication between the tuberculous focus and the renal pelvis leads to the appearance of clear urine secreted by the healthy remnant. A regional partial development of renal tuberculosis and the resulting partial seclusion, which may concern one or more renal segments up to half of the kidney, may in rare cases lead to a condition which can be interpreted as a cure with preserved function. However, this is not really a cure, he warns, but a partial elimination of the organ. Meanwhile the closed pathological foci represent a constant and serious danger for the

patient so that even the apparently most conclusive and best supported results obtained by conservative treatment possess only a very doubtful value. The process of exclusion of a tuberculous kidney while it explains the retrogression of the urinary disturbances cannot be regarded as a curative process in the real sense of the term.

These remarks are well illustrated by Cases and 5 cited above.

Harbitz (20) expresses a more positive view regarding the possibility of spontaneous healing, which he considers a not uncommon occurrence. In autopsies he states it is not uncommon to find evidence of a slow spontaneous cure in the form of completely encapsulated lesions of the kidney which are first discovered as accidental post mortem finding. In many of these cases the renal tuberculosis has taken a chronic course (four to twenty years in this author's material).

Sometimes according to Harbitz there is a picture of a sclerotic inflammation the fibrous transformation and healing tendency preponderating so markedly that it is very difficult if not impossible to decide from the microscopical appearance whether a tuberculous inflammation is present or not. In other cases there is a completely encapsulated chronic renal tuberculosis where the inflammation has been arrested and the discharge of pus through the ureter has stopped. The cure may be so complete that a tuberculous inflammation in the remnants of renal tissue can be demonstrated only on careful microscopical examination (as in Cases and 5 cited above). In still other cases even the microscopical evidence is missing as in one of Harbitz' case and the diagnosis of renal tuberculosis being cured by encapsulation can be rendered only on the basis of the entire macroscopical picture and the remaining autopsy findings.

Morris (21) asks the question: How often do patients recover spontaneously from tuberculosis of the kidney? which forms the title of a contribution in connection with a case in which treatment for increasing resistance seemingly produced a cure. This case recalled to his mind some experiments

of his a number of years ago planned with the idea of determining if tuberculosis of the kidney could be brought to a stop by ligating the renal artery for the purpose of limiting nutrition or by ligating the renal vein for the purpose of causing hyperemia in order to obtain an effect in line with the work of Bier. Rabbits were injected with virulent cultures of test tube culture human tubercle bacilli the injections being made directly into the parenchyma of the kidney in some rabbits and simply beneath the fibrous capsule in others. The abdomen was opened in about a month when the tuberculosis was found well under way and closed again for further development before ligating the renal arteries and veins. Not being able to follow the experiments again promptly it was noted that rabbits which had shown various signs of illness were getting better. When the abdomens were finally opened (it is not stated how long after the commencement of the experiments) the tuberculosis had come to an end in some cases and nearly to an end in others. The rabbits finally recovered completely. If these rabbits comments Morris depending upon their own resources allowed tuberculosis to get well under way and then placed it under control with their own factors of protection it is a question if some of our patients with tuberculosis of the kidney will not be quite amenable to those resources which increase the general resistance of the patient.

O'Neil and Hawes (2) in line with this view hold that careful and constant supervision prior to any surgical procedure will vastly increase the benefit of such procedure and that this is particularly true in urinary and genital tuberculosis.

Dock (18) says regarding the possibility of spontaneous healing. The question in renal tuberculosis is important because if spontaneous healing is not probable in general medical treatment no matter how complete is at present less promising than extirpation if extirpation is possible.

Young (3) who followed Dock in the symposium on renal tuberculosis said. None of the reported cases on close examination fulfill all of the requirements necessary to estab-

lish definitely the proof of a cure and many of them do not have all of the data possible to obtain during life.

Referring to the immunizing treatment advocated by many Young says

If we reverse this evidence we find in it a very strong suggestion that there is no process going on in the body in this disease which has any marked tendency to cause healing or else the immunizing process would not be necessary. This seems to me to be the keystone to the whole question. If a person has a strong natural immunity to start with an initial infection will not gain a foothold. If a process does start in the kidney the slow course of the formation of antibodies in comparison with the spread of the lesion allows the disease to get beyond the point where it can be entirely obliterated although it can often be walled off so efficiently that the symptoms cease and the condition becomes latent but capable of further mischief if for any reason it gets loose.

From a study of the cases reported in the literature from pathological study and from reasoning in connection with immunization Young concludes that the healing of a tuberculous focus in the kidney is impossible.

The foregoing rather extensive review of the literature on renal tuberculosis for the past five years has been made and exact quotations taken from the various writers in order that a present day analysis might be made of this important disease and its proper management.

The past five years represent the highest development in urological progress due largely to the accurate study of cases the placing of urology on a par with other specialties and the closer association of the urologist with those in other branches of medicine and surgery.

The observations of the writer from his own cases and those studied in conjunction with others coincides in the main with the opinions of the writers who have contributed to the subject during the past few years.

CONCLUSIONS

The present status of renal tuberculosis may be summarized as follows:

1. Renal tuberculosis may be a primary lesion and arises from a filtration of tubercle bacilli from the blood stream into the parenchyma or tubules of the kidney where tissue

changes similar to those found in tuberculous foci in other parts of the body take place

2 An effort is always made to wall off the process but the formation of antibodies is so slow and the immunity of the patient which may have always been absent or which may have been temporarily diminished is so low that the lesion usually gets beyond control and usually goes on to wide destruction of the kidney and extension to the other kidney to other parts of the urinary tract and of the body

3 From the nature of the lesion remissions are common

4 The symptoms of renal tuberculosis are misleading often slight at the onset and give no indication of the extent of the lesion

5 The diagnosis of renal tuberculosis may be simple or the most difficult of all urinary lesions often requiring preliminary treatment to allay acute symptoms and repeated cystoscopic examinations over a long period of time

6 The treatment cannot be outlined from a study of the symptoms The remission of symptoms often for long periods of time should not be accepted as a cure

7 The effort on the part of nature to inhibit the progress of the disease and to limit the lesion should be borne in mind utilized and encouraged in every possible manner in inoperable cases as well as before and after operation

8 While this review shows that many others have had cases similar to two of the writers where the active tuberculous process has been arrested and walled off still this is not the rule the lesion being progressive Even when arrested a kidney the site of poorly drained cavities is a menace to the system Therefore nephrectomy for unilateral renal tuberculosis is the proper treatment

9 With the means at hand by which we can often make an early and accurate diagnosis of renal tuberculosis and with our statistics showing that 75 per cent of the cases of unilateral infections are cured by nephrectomy the tendency is to be too optimistic

as to the future in these cases They should all report regularly be watched and treated as cases of general tuberculosis

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PEPTIC ULCER¹

By JOHN B. DEAVER, M.D., F.A.C.S., PHILADELPHIA

THERE is probably no subject that is more frequently discussed at gatherings of this kind than that of peptic ulcer and there is probably also none in which discussion has proved more valuable and instructive. Nevertheless there is still lacking a definite knowledge of the underlying causes and the mechanism of the development of these ulcers and unanimity as to the best method of treatment once they have occurred. I have on so many occasions emphasized my conviction that the basic factor in the development of peptic ulcer is infection that it seems almost superfluous to further insist upon it. The toxemic origin of peptic ulcer is generally recognized and there seems little doubt that infection is the primary cause of the toxæmia in the vast majority of cases. Furthermore clinical experience in recent years is indicating more and more clearly that the original site of the infection lies in the vermiform appendix and Rosenow's demonstration of the elective localization of micro organisms especially streptococci is additional confirmation of the infectious origin of these ulcers and similar lesions. Indeed Rosenow's studies show that the cells of the tissues for which a given strain of bacteria shows an elective affinity may take bacteria out of the circulation as if by a magnet—absorption. From Bolton's careful histological studies we learn that the initial lesions which give rise to ulcer of the stomach are localized necrosis of the mucous membrane, localized hæmorrhage and inflammation of the lymphatic follicles. The common cause of necrosis is bacterial infection or its toxins circulating in the blood stream and as pointed out by Bolton the cells of the gastric mucosa being primarily attacked by the poisons in the circulation necrosis is readily produced by the local action of the gastric juice. Necrosis may arise in this way without any preceding hæmorrhage or lymphatic inflammation but hæmorrhage is an actual and frequent cause of ulcer and is likewise due to bacterial toxins circulating in the blood stream which destroy

the endothelial cells of the capillaries pave the way for the local destructive action of the gastric juice. Finally inflammation of one or more of the lymphatic follicles so thickly studded along the lesser curvature of the stomach especially toward the pylorus may give rise to a submucous abscess which by rupture into the gastric cavity allows the juice to act on the base of the ulceration thus exposed.

Ulcers developing in one or the other of the processes mentioned would heal in a normal stomach but being constantly exposed to the action of the frequently hyperacid gastric juice they show a tendency to spread rather than to heal and sudden perforation or hæmorrhage is often the first indication of gastric ulcer. Or in cases of simple ulcer the tendency is to become callous with chronic peptic ulcer as the result. There is little doubt that every chronic peptic ulcer was at one time acute and began in one of the aforementioned processes.

If the early symptoms are sufficiently pronounced as to demand and receive attention the ulcer may heal but owing to their insidious character these ulcers do not as a rule present early definite symptoms and the longer they remain unhealed especially if situated on the lesser curvature near the pylorus the less amenable are they to medical treatment. In fact it is doubtful whether a true peptic ulcer as distinguished from an erosion ever heals under purely medical treatment. The so called cures represent a latency which there is no telling how soon is apt to be aroused to activity. It is of course rather difficult exactly to estimate the relative proportion of medical and surgical cures of peptic ulcers. But we do know as Coffey aptly remarks that every case that comes to the operating table represents a medical failure and perhaps several failures on the same individual. The frequency of such failures is readily seen by the increasing number of cases operated on that are reported from the larger hospitals throughout the country. In

my own experience I have operated on 73 peptic ulcers during the year just passed compared with 60 during the year 1916 an increase of 18 per cent. There is to be sure no way of telling whether this increase is the result of a wiser counsel prevailing among internists as a consequence of the more or less forcible arguments presented by the revelations of the operating theater as to the better method of treating peptic ulcers or whether it is due to an actual increase in the incidence of this form of gastro intestinal disturbance as the result of modern living conditions. To attribute it to a combination of the two factors would probably provide unction for both the surgeon and the internist. Be this as it may there is little doubt that the improved diagnostic aids at our disposal have to a large extent led to a greater degree of certainty in diagnosing the presence of deformities and functional derangement of the gastro intestinal tract for the greater number of which surgery is the only rational treatment. With the aid of the X ray and the various clinical tests and a carefully taken history a correct pre operative diagnosis of ulcer has been made in 88 per cent of our cases during the past year.

As it is we surgeons are free to confess that we have not yet attained the ideal of 100 per cent of cures by our methods. We are still being confronted with a sufficient percentage of recurrence of symptoms after operation to keep us humble even though we can claim that from 75 to 90 per cent of operated cases are either completely cured or so greatly benefited as to require no further medical treatment. Of our patients operated on for peptic ulcers during the past 18 months 90 per cent of those traced reported complete cures.

Percurrences indicate primarily that a certain number of cases have by operation been merely placed in a *status quo ante* as to their liability to develop peptic ulcer and secondarily some fault in the method of operation.

For a chronic ulcer of the duodenum we believe that excision of the ulcer is the best method of treatment. If the ulcer is easily accessible which it usually is if located on the anterior or outer wall of the bowel its com-

plete removal by excision presents no difficulty. But where there is marked and extensive induration complete excision of an ulcer is not always an easy operation indeed it may be a dangerous one except in the hands of the experienced abdominal surgeon. The occasional operator in such a case had better content himself with a gastrojejunostomy. For a time it was our practice in treating ulcers located low down on the duodenum to excise the ulcer and implant the duodenal stump into the head of the pancreas. But our experience has been that in two instances the digestive action of the pancreatic juice has resulted in the formation of duodenal fistulae necessitating a secondary operation. We have therefore abandoned the practice and in such cases we now do nothing to the ulcer but infold the wall of the duodenum and adjacent gastroduodenal and gastrohepatic omentum over the ulcer and make a gastrojejunostomy. The latter procedure in fact is considered by Moynihan and others as of itself sufficient for the cure of duodenal ulcer. While we consider it an integral part of the treatment of all ulcers of the duodenum we believe that the surgeon's first effort should be directed toward the removal of the diseased area and that gastrojejunostomy as a supplementary operation though generally effective in preventing a recurrence cannot always be relied on of itself to cure a fully developed chronic ulcer.

Not only is it necessary to treat the ulcer at the time of operation but it is equally important to endeavor to discover the focus of intra abdominal infection that is the real offender in the case. It is therefore essential to inspect the biliary tract and drain or remove the gall bladder according to existing conditions the frequency of an accompanying pancreatitis should be borne in mind in this connection. In our cases during 1917 we found disease of the biliary passage present in 16.3 per cent of chronic peptic ulcer.

Above all we should not omit the removal (unless contra indicated which is rarely the case) of the appendix that obnoxious or an which is the most constant source of intra abdominal infection. We are fully in accord with Moynihan when he says that the com-

monest site of gastric ulcer is in the right iliac fossa and that in the majority of cases in which the most erudite teaching of the most astute German physician would justify or compel a diagnosis of ulcer the patient is often suffering from a lesion elsewhere and more often than not in the appendix. The appendix can be removed either through the same incision as that used for the exposure of the upper abdomen or through a separate McBurney incision. We prefer the latter method.

Excision of a gastric ulcer would be as desirable as it is for ulcer of the duodenum were it always as safe and always feasible. While we consider it best suited for ulcers located at some distance from the pylorus we do not hesitate to say that it should be the operation of first choice in indurated ulcers irrespective of location that is to say pyloricotomy or partial gastrectomy for pyloric ulcers wedge shaped or circular resection of ulcers on the lesser curvature for ulcers on the posterior wall transgastric resection or resection by way of the entero colo-epiploic route. By this same route ulcers on the posterior wall of the duodenum adherent to the pancreas with few exceptions are rendered accessible and amenable to excision. We would add however that a conservative selection of cases is essential and excision should be attempted only in the absence of encumbering adhesions and where the patient seems able to withstand what often proves to be a rather tedious operation.

Ulcers on the posterior wall of the stomach invading the coats are best exposed and disposed of by dissecting the gastocolic omentum from the transverse mesocolon lifting up the great omentum when the entire posterior wall of the stomach may be beautifully shown also the duodenum and pancreas. This exposure very materially facilitates access to ulcers that otherwise would be difficult to deal with.

Destruction of an ulcer by actual cautery is a method originated by Balfour at the Mayo Clinic where it has been done with marked success. We have had no experience with this method of treating gastric ulcers.

A careful selection of cases is also essential

for the success of pyloroplasty as advocated by Finney.¹ While in his hands the immediate mortality has been lower than for gastrojejunostomy (5 and 7 per cent respectively) this is not the experience of most surgeons. Finney also reports better end results from his operation than from gastrojejunostomy (93 and 94 per cent cures, respectively). We believe that Finney's method of pyloroplasty should be employed only where gastric motility is good where perigastritis is absent and where the pylorus is not involved in cicatricial tissues. As there are few cases presenting these favorable conditions the operation would have only a limited application. Adhesions are nature's safeguard and should be treated with respect. In not a few instances adhesions represent barriers guarding a threatening perforation or an area of a previous chronic or subacute perforation. Injudicious destruction of such adhesions may open up a perforation into the stomach which may not be amenable to closure by suture and will also subject the patient to the risk of septic peritonitis from the unexpected and sometimes undiscovered extravasation of gastric contents. The safer course we believe is to do a gastrojejunostomy in a healthy stomach wall and let nature's barrier remain undisturbed. The more marked the pyloric stenosis the more certain are the benefits to be expected from gastrojejunostomy. Furthermore where the pylorus is much obstructed it is also involved in cicatricial tissue an extremely unsuitable site for incision and suture. Stitches as we all know do not hold well in scar tissue nor does it lend itself so well to an anastomotic operation as does normal tissue, both because of its rigidity and its lack of blood supply. Still where the pylorus is an obstructive factor without being ulcerated or the seat of cicatricial tissue Finney's operation may prove of value.

On the other hand gastrojejunostomy has been proved by clinical experience the best standard of success as admirably fulfilling the surgical requirements for the treatment of gastric ulcer. The death rate is low collected statistics place it at not more than 10 per cent and in the hands of some surgeons it is

negligible. There were no deaths in our cases of gastric ulcer operated on in 1916 and 1917 treated with posterior gastro enterostomy as a combined or as the only operation. The end results also of the operation in the treatment of pyloric ulcers where there is no pyloric obstruction are most satisfactory. While it is not always the best procedure for all ulcers located elsewhere in the stomach it is even in these undoubtedly the least dangerous and the most generally applicable operation in the hands of those who are not doing many operations for excision. If the anastomosis is made not in the fundus of the stomach but in the pyloric antrum the anastomotic opening will functionate even when the pylorus is patulous and even though the gastric contents do not leave the stomach through the new opening but are still being discharged through the pylorus gastrojejunostomy is a curative measure for the ulcer inasmuch as it reduces hyperacidity by permitting the admixture of the bile and pancreatic juices with the stomach contents.

The question of exclusion of the pylorus as an aid to gastro enterostomy in the cure of gastric ulcers is still a matter of discussion. We believe that the only theory on which it can be held of value as a primary operation is that which teaches that gastro enterostomy is of benefit not because (as has been hitherto considered its most desirable effect) it admits an excess of alkaline duodenal secretion to the stomach but by merely accelerating the evacuation of the stomach it lessens the time during which peptic corrosion of the ulcer can take place. Sippy¹ supports this view arguing that pepsin acts only in acid medium and as the acidity of the gastric juice depends largely on the presence of food in the stomach the only good gastro enterostomy can do is to accelerate the evacuation of food from the stomach as long as the pylorus is even partially open little or no gastric contents will pass by way of the new opening and it is therefore of little value but if the pylorus is occluded (by stenosis from ulceration or by ligation or plucking etc.) then the new opening serves for evacuating the stomach and does so in less than the normal time. We

believe that Sippy overlooks the fact that in duodenal ulcer the stomach is often emptied through the pylorus in less than the normal time and nevertheless the addition of a gastrojejunostomy promotes the healing of the ulcer without further accelerating the evacuation time. The only reasonable conclusions thus it seems to us is that the value of gastro enterostomy lies in the increased alkalinity of the gastric contents obtained by admitting to the stomach through the anastomotic opening the alkaline duodenal secretions. Therefore it seems doubtful whether primary occlusion of the pylorus is of any value.

Vicious circle following gastro enterostomy is a very unusual occurrence in these days but so called marginal ulcers developing around the gastro enterostomy opening are unfortunately still being recorded although the percentage of cases is small. During the past two years we have had occasion to treat four marginal ulcers. In two instances the original operation had been performed by us at the Lankenau (formerly the German) Hospital of Philadelphia. The histories of these two cases follow.

M. D. female age 47. Operated on April 1, 1907 for gastric ulcer, hour glass stomach, cholelithiasis. Operation consisted of gastrogastrostomy, posterior gastro enterostomy and cholecystostomy. Recovery was interrupted by phlebitis. The patient was well until January 9, 1915 when she suffered a severe attack of sharp epigastric pain which came on immediately after eating. There was no sea but spontaneous vomiting. Relief was obtained by self induced vomiting. Several similar attacks followed this one but none was so severe as the first one. She also gave a history of occasional hunger pain relieved by food. The bowels were constipated, stools dark. Occasional dry cough. Loss of eight pounds in four weeks.

Operated on April 7, 1916. The stomach as exposed and the adhesions round the gastro enterostomy separated. The old gastro enterostomy opening was patulous. Subtotal gastrectomy was done with Roux-Y anastomosis. Recovery.

The case was no reply to the inquiry sent concerning the ultimate result of the operation.

H. A. male age 28. Operated on April 9, 1915. An ulcer was found on the second part of the duodenum. The duodenum was plated over the ulcer after which a gastrojejunostomy was done. The appendix was removed through a McBurney incision. It contained many fecal concretions. Uneventful recovery.

The patient was well four months when periodic attacks of epigastric pain returned. The pain was cramp like but not severe and had no definite relation to eating. No nausea and no vomiting. The patient was re-admitted to the hospital February 2 1917. About eighteen hours before admission she was seized with a severe attack of pain. Examination showed slight rigidity and distention of the abdomen. peristalsis was present. X ray examination revealed partial constriction at the gastro enterostomy opening. At operation February 8 1917, the margin of the gastro enterostomy opening was found indurated and an ulcer presented at one centimeter on its upper border. The duodenum was patulous. A section of the stomach with the jejunum comprising the former anastomosis was excised the opening in the stomach closed and a new Roux Y anastomosis made. This patient reported no further digestive troubles ten months after operation.

Recently I have operated for perforated jejunal marginal ulcer occurring after a Roux Y operation in a subtotal gastrectomy. The latter operation was done for a marginal ulcer following a simple gastrojejunostomy for duodenal ulcer.

One of the most serious if not the most serious menace of chronic peptic ulcer is of course perforation. This complication is generally said to occur in about 4 per cent of all cases but the proportion is much greater if we consider only those cases that come to operation. For example in the entire series of operations for gastric and duodenal ulcer at the Lankenau Hospital of Philadelphia during 1916 and 1917 there were 13 acute perforations —, of gastric and 10 of duodenal ulcer or 10 per cent of the entire number of ulcers. All of the patients recovered operation having been performed in two to eleven hours after onset of symptoms in one case 3 days had elapsed between the first symptoms and the operation.

About 70 per cent of the perforations occur from ulcers on the anterior wall of the stomach those on the anterior wall toward the pylorus forming about 80 per cent of the total. About 18 per cent occur on the posterior wall while the fundus and the cardia are very exceptionally the site of perforating ulcers. The anterior wall of the stomach being exposed to the general peritoneal cavity and also subject to a greater degree of dilatation and contraction than is the posterior wall is also more exposed to traumatic influences. On

the other hand the posterior wall is more rigid and more protected and ulcer developing at this site is more liable to develop perigastric adhesions as soon as any peritoneal irritation occurs thus reinforced it is neither so apt to perforate nor in the rare event of actual perforation is it so likely to induce peritonitis.

The diagnosis of perforation of peptic ulcer is not a matter of great difficulty and in typical cases it is easily made by the hospital interne of average experience. The dominant symptoms are acute overwhelming pain vomiting fall of temperature rise of pulse shock occasionally and peritoneal reaction i.e. early rigidity followed in from 10 to 12 hours by distention. The differentiation between a perforating gastric or duodenal ulcer is not possible as a rule nor is it essential for the treatment for either or both is surgery and the earlier the intervention the better the prognosis.

Excision of an acute perforating gastric ulcer in our opinion is not only an unnecessary waste of time but it gives the surgeon a larger opening to close and in addition by the possible dividing of a large vessel it presents the risk of adding hemorrhage to an already desperate condition. Seromuscular suture of the perforation with linen without attempting to freshen its edges is sufficient. There are to be sure cases in which it is not possible to close the opening securely by suture. In such instances the perforation may be closed by suturing a tag of omentum over it or the gastrohepatic omentum may be anchored down to the perforation or the perforated area may be packed off with gauze as is done in other parts of the abdomen. Drainage is imperative. In perforated duodenal ulcer our procedure can be briefly summarized as consisting of closure of the perforation plication of the duodenum to obliterate its lumen and fortifying the area by covering with gastro colic and gastrohepatic omentum posterior no loop gastro enterostomy and drainage of the pelvis through a suprapubic wound. This should be done in all cases whether or not the epigastric incision is drained. Although in most cases in which operation is done within 12 hours after perforation the peritoneal exudate is sterile, it is not always so for the

colon bacillus in pure culture has been found in the pelvic exudate within less than five hours after perforation of a duodenal ulcer although clinically there was nothing to distinguish this case from others in which the exudate is sterile (Ashhurst personal communication)

We strongly disapprove of irrigating the peritoneal cavity even in late cases where particles of food can be distinguished in the exudate. Merely wiping away with moist gauze the small particles of food that are accessible gives the case a much better chance of recovery.

Primary gastrojejunostomy as a part of the operation for perforating gastric or duodenal ulcer is becoming more and more recognized as a useful procedure in properly selected cases and in the hands of the surgeon accustomed to working within the abdominal cavity.

Most surgeons agree that where closure of the perforation produces stenosis of the pylorus gastrojejunostomy as a primary operation is advisable. But we believe it suitable to all cases of gastric ulcer unless there is specific indication to the contrary. We have not had any cause to regret our practice which is not the case with surgeons who have omitted the operation in certain instances. Paterson for example states that among the cases of gastric perforation collected by him no less than 13 deaths in 58 cases could have been avoided had a primary gastroenterostomy been done. Indeed Paterson goes farther than we should be inclined to go in stating that even purulent peritonitis is no contra-indication to the operation. Caird was obliged to do the operation three days after suture of a perforation on account of stenosis of the pylorus. Allingham and Thorpe² resorted to it one month after operation in order to hasten convalescence and Scudder found it necessary

five weeks after and Gibbon⁴ eighteen months after suture of a gastric ulcer.

For perforating gastric ulcer also we advocate primary gastroenterostomy. Early operation is a vital factor in the prognosis of these cases. We do not consider shock unless severe as contra-indicating operation yet if it is a question of immediate operation it may be one for careful consideration. Shock it appears is to a great extent due to the evacuation through the perforation of gas and intestinal contents and the sooner the peritoneum is opened to allow the escape of the gas and the extravasated matter and the sooner the perforation is closed the better for the patient. If the duodenum is bound down by adhesions and the site of the perforation is not easily accessible a large pillow placed under the lower dorsal spine as in operation on the biliary tract will prove of considerable assistance in bringing the duodenum nearer to the abdominal incision. The perforation should be closed with linen sutures and reinforced with a tag of omentum when necessary. Unless the peritonitis is extensive and the patient's condition is grave we do a primary gastroenterostomy. We also remove the appendix, examine the gall bladder and pancreas and if either of the latter is diseased we deal with it as indications present.

In a few cases in which the duodenum was extremely friable and the perforation could only be imperfectly closed resulting in temporary leakage of duodenal secretion and bile we feel confident that the recovery of the patient was largely due to the gastrojejunal anastomosis. This is especially true in subacute perforation of the stomach and duodenum unexpectedly discovered at operation for a supposedly uncomplicated simple lesion. In such cases it is not always possible to make sutures hold in the region of the perforation. Repeated attempts to do so result only in enlarging the bowel opening while resection is entirely out of the question. The patient's salvation lies in a gastrojejunostomy.

¹ P. S. D. Ashhurst S. G. F. H. Upp. A. F. D.
C. d. Ed. b. M. J. 1. 8
Allingham m. d. Thorpe L. L. d. G. 886

Gibb T. C. H. Fy. Phil. G.

RADIUM IN THE TREATMENT OF CERTAIN TYPES OF UTERINE HÆMORRHAGE AND UTERINE FIBROIDS¹

By C. JEFF MILLER, M.D., F.A.C.S., NEW ORLEANS

INTEREST in radium as a therapeutic agent has been centered chiefly in its promising possibilities as a cure for cancer. The original claim as to its wonderful properties has been modified by extended observation but it still offers the most hopeful outlook as a palliative and occasionally the curative treatment of inoperable cancer. Its absolutely original properties have hampered clinicians in their effort to estimate its just merits as a remedial agent but extended use of it in various pathologic conditions has developed the fact that it possesses other properties equally as striking as its ability to destroy cancer cells. The promptness with which certain types of persistent uterine bleeding respond to radium exposures places it in the same category of specifics with quinine and the serum for diphtheria.

The term *uterine hæmorrhage* as employed here is limited to bleeding due to metropathies, disturbed ovarian function, chronic endometritis, metritis and fibroids of the uterus. Bleeding associated with syphilis, chronic liver and heart, lung and kidney affections, as well as the ordinary complications of pregnancy, is naturally eliminated and mentioned to emphasize the point that uterine bleeding is only a symptom and demands careful differentiation and accurate diagnosis in its management.

Every gynecologist is impressed with the large number of cases of persistent bleeding that eventually require hysterectomy. If he is conscientious, he can only regret keenly the necessity of performing a serious mutilating operation especially when the pathologist reports little if any pathologic changes in the uterus. Radium has proved to be the long-sought specific in these cases because of the simplicity of application, the short amount of time required to effect a cure and the uniformly satisfactory results obtained.

It has been known since 1904 that roentgen ray exposures would control bleeding asso-

ciated with fibroids of the uterus. It was subsequently shown that this effect was due to marked structural changes produced in the primordial cells of the ovary and since the degree of ovarian stimulation governs menstruation, the depression of this function leads to a decrease of blood supply and ultimate shrinkage of the fibroid.

While the structural changes produced in the ovary by radium exposures are identical with those induced by the X-ray, the control of bleeding is probably accomplished in a different manner.

Wickham's early investigations showed that the most constant effect produced by radium was the marked change in the intima of the blood vessels which eventually resulted in endarteritis and blocking of the vessel lumen. Wickham's results in the use of radium in the treatment of vascular nævi prompted Abbe to use it in a case of bleeding associated with a large fibroid that presented some hazardous surgical features. The bleeding was not only controlled but the fibroid almost disappeared. Abbe's experience was soon verified by other clinicians and it was shown that radium not only has almost a specific effect in relieving the commonest complication of fibroids of the uterus, viz. hæmorrhage, but will cause a rapid reduction in the size and in many instances complete disappearance of the growth.

There is abundant evidence to prove that this effect is not produced by structural changes in the ovary. It will promptly arrest persistent hæmorrhage that occasionally occurs after double oophorectomy in fibroids long past the menopause, an amount of radium apparently too small to radiate the area between the uterine cavity and the ovary will often effectively correct menorrhagia.

Kelly and Burnham believe that in addition to the anæmia following the occlusion of the vessels it exerts a specific and direct effect independent of any action upon the ovaries.

The most plausible explanation is that it produces extensive structural changes in the endometrium

During the past three years I have used radium in a series of cases that ordinarily would have been subjected to hysterectomy. Most of the cases treated during the first year were referred for radical surgical treatment and are the most valuable in a statistical study because they were of the aggravated type and present some idea of the permanency of the results.

The histories also allow some deductions to be drawn as to the type of cases in which radium is indicated, the primary and ultimate results as well as some contra indications to its use.

An attempt has been made to arrange the cases in groups according to pathologic findings but it has been difficult to make satisfactory classifications owing to the presence of one or several lesions in the same patient.

The classifications are similar to those proposed by Kelly and Burnam in a recent contribution but differ in several details.

The first group includes the cases commonly denoted as *myopathia hæmorrhagica* (hæmorrhage of the menopause) or as Graves prefers to classify them uterine insufficiency. These cases present as a rule little if any defined anatomic cause to account for the bleeding and comprise some of the most serious instances of acute hæmorrhage. It occurs most commonly in women approaching the menopause though it may be found in comparatively young women. The uterus may be normal in size or slightly enlarged and often presents a normal endometrium. The bleeding is supposed to be due to a disproportion of connective tissue over muscular tissue in the myometrium or to some aberration of ovarian secretion or other ductless glands.

There were 8 cases in this group and a glance at the resume of cases will convince the experienced surgeon that had not radium been available most of them would have been subjected to hysterectomy. All but 1 had been curetted several had been curetted twice and one as many as five times. 2 had been treated by prolonged X-ray exposures. Six cases received only one application of

radium. Two cases required two applications. All but two menstruated once after the application. One half of the number reported menopausal symptoms. One case living at a distance reported only temporary relief and had a second application made elsewhere. A late report from this case states that she was cured. The dosage had been made small in this case with the hope that the flow would be reduced and the menstrual function preserved.

The bleeding was controlled primarily in 100 per cent with 90 per cent of permanent results. The average time from the treatment until amenorrhœa occurred was four weeks.

The second group included patients presenting a history of menorrhagia or metrorrhagia lasting for months or years practically all of whom had a uniformly enlarged hard or occasionally flabby uterus. Many gave a history of puerperal complications. In some the origin of the trouble appeared to be extensive lacerations of the cervix involving the parametrium. These cases are ordinarily classified as chronic metritis, polypoid endometritis, hyperplasia, fibrosis, etc. I desire to emphasize the point that none of this group was of the type usually relieved by curettage, plastic operations, etc. for a glance at the histories will show that practically every one had been subjected to some such treatment and more than half were referred for some radical surgical measure.

A point also to be emphasized is that so far as could be determined none of this group showed a latent tubal infection.

The intra uterine manipulations necessary in the application of radium make it essential to minimize the risk of stirring up a dormant tubal disease by a careful selection of the cases. Two rather unpleasant experiences fully illustrate this point. One promptly developed a pus tube that required vaginal incision and drainage, the other passed through an attack of salpingitis that fortunately subsided without serious damage.

There were 18 cases in this group varying in age from 1 to 55 years with an average of 40.7 years. Amenorrhœa was produced in every case within one month after treatment. Only one case reported a return of the menses.

She menstruated for eight days one year after the application. The flow was not profuse and she was advised to delay further treatment until it was determined whether it would be necessary.

Thirteen cases received one application, 5 received two. Cases living at a distance were given two applications in order to avoid a possible second trip in case of failure.

This series gives some idea of the duration of the results. All but two have been recently communicated with and none reports a return of the bleeding. Many presented an enlarged uterus before treatment. Every one examined three months or longer after the treatment showed a uterus approximately normal in size. The menopausal symptoms seemed to be more pronounced in this group than in any of the other series. Five cases reported the flushes to be very severe and 2 insisted that they would prefer the bleeding to the flushes and nervousness. Five patients who complained of the menopausal symptoms were benefited by corpus luteum extract which seemed to be more effective when given hypodermically. This series gives a very fair estimate of the therapeutic value of radium. All were anæmic nearly all had submitted to some form of surgical treatment without relief and all but 2 have regained their normal health.

The group of myomata comprises 6 cases. The average age was 40.5, the youngest was 29, the oldest 48 years. Menorrhagia or metrorrhagia was present in all the cases. So far as could be determined by examination the appendages were involved in only 2 cases. Cystic disease of the ovaries and hydrosalpinx are frequent complications of fibroids but if the history of the case and physical examination revealed such complications operation was advised in preference to radium.

The 2 cases that failed to respond to treatment gave evidence of a chronic salpingitis.

Two cases of the series illustrate conclusively that radium is more effective than the X-ray. Both had been given 10 exposures by an experienced radiologist who employed the Gauss technique with only temporary results. Only one intra uterine application

of radium sufficed to stop the bleeding permanently.

In one instance bleeding was checked by two exposures in which the fibroid was as large as a seven months pregnancy. She had marked anæmia and cardiac changes that would have made the outcome of a surgical operation extremely doubtful. She improved rapidly and three months after treatment the growth was successfully removed.

In 2 cases the bleeding ceased within 3 weeks and has never returned. In 5 it was controlled for a few months but was never so severe after its reappearance. In 7 of these the menses became regular after 8 months. In only 1 case has the radium failed and these would very probably have been relieved by another radiation.

Control of bleeding is not the only desideratum in treating fibroid tumors. The growth of the tumor must be stopped and if possible the tumor be made to disappear. It was not possible to ascertain the change in size of the fibroid in 11 cases.

In 16 cases examined from three months to two and one half years after treatment there had been a reduction in the size of the tumor varying from complete disappearance in three cases to about one half of the original size in practically 50 per cent of the number.

Some further points in regard to the fibroid group are worthy of comment. It will be noted that most of the growths selected for radium treatment were small, the only large tumors being those presenting contra indications to operation.

This feature is emphasized because I do not wish to imply that radium is to supplant surgery in the treatment of fibroids. I wish to show that it is a most valuable adjunct to surgery. The average uncomplicated fibroid can be removed by a competent surgeon with very little risk to the patient but there is a fairly large percentage of cases that are hazardous surgical risks among which might be mentioned the cases presenting cardiac and renal lesions and marked anæmia. Since I have made it a rule to study the blood pressure in all cases of fibroids I have been amazed to learn how many present an extremely high vascular tension even when

they show a severe type of anæmia. In such cases rest, diet and radium may relieve the situation altogether or convert the case into a safe surgical risk.

If the only annoyance a woman experiences who suffers from a fibroid is bleeding, is there sufficient justification for performing hysterectomy? My experience with radium prompts me to answer in the negative. If the growth is sufficiently large to produce pressure symptoms, operation is preferable because of the time consumed in reducing it by radium. If evidence of infection or degeneration exists or the appendages are diseased, operation is the best procedure. If the woman is young, she should be advised to submit to operation with the idea of performing myomectomy and preserving the uterus.

For small or medium sized growths and those presenting contra-indications to operation, radium is the ideal remedial agent.

Submucous growths should be treated surgically unless contra-indications to operation are present, owing to the tendency of this type to become infected or develop other degenerative changes.

In a fourth group I desire to record cases of serious uterine bleeding in young girls who had been treated by rest, tonics, astringents, ovarian extract and curettage. The uterine scrapings showed hyperplastic glandular endometritis. Their ages were 15 and 16 years. The pelvic organs were apparently normal. The hæmorrhage had been so severe in 1 case that transfusion had been considered. Short exposures with 25 milligrams of radium element were made with the hope that the flow could be reduced without producing amenorrhœa. Each received three hour applications twice, the treatments being given 2 weeks apart.

The result has been all that could be desired, even though the risk of permanent amenorrhœa was greater than should be taken in the ordinary case of this type. Both now menstruate regularly after a period of amenorrhœa which lasted 3 months.

While the results obtained by various authorities are practically the same, the dosage employed has been by no means standardized. It has been practically es-

tablished that a 1000 milligram hour exposure or in other words 50 milligrams of the radium element introduced into the uterine cavity for 20 hours is almost certain to produce permanent cessation of the menses. Some employ larger doses and longer and repeated exposures, but many of the cases herewith reported show that the desired results may be obtained with smaller dosage.

In fibroids, the size of the growth and the degree of hæmorrhage should govern the amount used and the duration of the exposures.

If conclusions may be drawn from a limited number of cases, it has been proved that radium possesses almost a specific effect in the control of certain types of persistent uterine hæmorrhage. It possesses every advantage over X-ray treatment in that it acts promptly, is free from the risk of cutaneous burns, is easily applied and acts by producing changes in the endometrium or uterus rather than in the ovaries. It will reduce the size of probably 80 per cent, cause the disappearance of many fibroid tumors and if carefully used, excessive menstruation may be reduced without causing amenorrhœa.

Those who have had experience with radium must agree with Kelly and Burnam who state that in its brilliancy of curative results it is fully equal to radical surgical procedures while offering the advantages of freedom of pain and the various postoperative complications and sequelæ. Furthermore, when radium fails, we still have the operation to fall back on and have lost nothing in the waiting.

Since such results may be obtained by a method of treatment that entails only one or two days' confinement to bed and which causes only temporary discomfort amounting to little more than nausea or uterine colic, we must accept radium as a most valuable and necessary adjunct to gynecological surgery.

GROUP I — CASES OF MYOPATHICA HEMORRAGICA

CASE 10. May 1915. Age 4. Severe hæmorrhage for ten days each month. Extreme nervousness, dysmenorrhœa, seborrhea, dysuria, slight enlargement of uterus. Pelvic treatment, medicinal twenty-three X-ray exposures. On May 1915

5 milligrams for twelve hours November 1916
52 milligrams for twelve hours Menstruated three times after first radium application menses reappeared November 1916 second application followed by amenorrhœa marked menopausal symptom

CASE 1 October 1914 Age 46 Severe menorrhagia dysmenorrhœa Uterus slightly enlarged Previous treatment medicinal curetted twice cervix amputated two years previously Radium treatment of 52 milligrams for 16 hours Prompt cessation of menses menopausal symptoms very slight no return up to March 1917

CASE 14 December 1914 Age 45 Menorrhagia for six years dysmenorrhœa Uterus slightly enlarged Previous treatment medicinal curettage Radium treatment of 52 milligrams for sixteen hours Amenorrhœa one period after application no return to March 1917

CASE 10 May 1916 Age 39 Menorrhagia for five years severe dysmenorrhœa metrorrhagia for last three months Uterus slightly enlarged Previous treatment curetted four times with only temporary relief Radium treatment of 52 milligrams for fourteen hours Not relieved by treatment wrote in November 1916 he would have radium treatment repeated in Chicago

CASE 23 August 1915 Age 25 Menorrhagia from beginning of menstrual period metrorrhagia for four to six months at a time anæmic Uterus of normal size Previous treatment curetted six times in five years small cyst removed from right ovary five years before radium treatment twenty eight X ray applications without relief Radium treatment of 77 milligrams for seventeen hours Amenorrhœa one period soon after application vaginal discharge for about two months one short period eight months later still well March 1917 no menopausal disturbances gained weight not nervous

CASE 22 July 1915 Age 35 Metrorrhagia lasting three months four times during two years Uterus slightly enlarged Previous treatment curetted May 1914 small polypus removed from cervix bleeding continued July 1915 25 milligrams for ten hours October 1915 5 milligrams for nine hours Bleeding stopped for two months but second application necessary after which amenorrhœa was complete slight menopausal symptoms in splendid health February 1917

CASE 30 October, 1915 Age 35 Dysmenorrhœa metrorrhagia Uterus undersize Previous treatment has been curetted twice without results October 1915 52 milligrams for two and a quarter hours For six menstrual periods the flow was reduced to three days no recent report short period of exposure in order to preserve menstrual flow

CASE 148 September 1916 Age 45 Menorrhagia for five years severe anæmia Uterus about normal size Previous treatment curetted without relief one year previous September 1916 //

milligrams December 1916 amenorrhœa after first period slight menopausal symptoms color good gained weight

GROUP II—BLEEDING FROM HYPERPLASTIC ENDOMETRITIS AND CHRONIC METRITIS

CASE 16 March 1915 Age 38 Severe menorrhagia for four years nervousness anæmic Appendages normal uterus about twice normal size and sensitive to pressure Previous treatment often required packing to control bleeding curetted twice without relief scrapings showed hyperplastic endometritis Radium treatment of 52 milligrams for sixteen hours Bleeding ceased ten days after application amenorrhœa since had leucorrhœa for about six weeks after treatment some bladder irritation occasionally but had similar trouble before treatment general health much improved uterus of normal size

CASE 28 August 1915 Age 37 Menorrhagia several times metrorrhagia very nervous anæmic leucorrhœa history of puerperal infection Uterus about twice normal size sensitive to pressure appendages apparently normal Previous treatment curetted twice with temporary relief cervix amputated for bad laceration and cystic disease Radium treatment of 52 milligrams for twenty hours Amenorrhœa in March 1916 stated that occasionally a bloody stain appeared profuse leucorrhœa October 1916 bleeding had returned

CASE 24 October 1915 Age 35 Menorrhagia for ten years metrorrhagia five months before treatment extreme anæmia hæmoglobin only 20 per cent Uterus about three times normal size scrapings showed polypoid endometritis Previous treatment packing medicinal Radium treatment of 77 milligrams for fourteen hours Prompt amenorrhœa gained weight rapidly recent report states that she is well no menopausal symptoms

CASE 18 April 1915 Age 37 Menorrhagia dysmenorrhœa anæmia Body of uterus slightly enlarged Previous treatment curettage amputation of lacerated cervix scrapings showed hyperplastic endometritis April 1915 52 milligrams for fourteen hours May 10 1915 5 milligrams for fourteen hours First period following application very painful and the flow profuse afterward amenorrhœa flushes and nervousness marked for a time leucorrhœa for two months general health much improved

CASE 21 June 1915 Age 21 Metrorrhagia for several months Uterus slightly enlarged Previous treatment curette both tubes left ovary and portion of right ovary removed June 1915 5 milligrams for twenty four hours Prompt amenorrhœa after one period No further return of trouble

CASE 4 February 1916 Age 44 Severe metrorrhagia for four years lasting ten days Uterus about twice normal size Previous treat

ment curettage imputation of badly lacerated cervix bleed not influenced polypoid endometritis February 1916 77 milligrams for twelve hours Amenorrhœa after first period Fluores for four months no return of trouble March 1917

CASE 85 February 1916 Age 49 Menorrhagia for ten years menorrhagia for ten years anæmia Uterus about twice normal size Previous treatment curetted about four times without relief scrapings showed hyperplastic endometritis February 1917 milligrams for twenty-four hours February 1930 dose repeated Prompt amenorrhœa no menopausal symptoms last report states that she is perfectly well

CASE 86 March 1916 Age 37 Severe hæmorrhœa menorrhagia for two years Chronic metritis uterus enlarged sensitive tube apparently normal Previous treatment curetted twice without more than temporary results March 1916 milligrams for twenty-four hours Amenorrhœa until March 1917 then profuse flow for eight days menorrhagia at regular time in April 1917 flow was profuse uterus normal size

CASE 87 May 1916 Age 43 Menorrhagia severe dysmenorrhœa Uterus enlarged tender hard Previous treatment curetted May 1916 milligrams for ten hours June 1916 52 milligrams for fourteen hours Menstruated once then periods ceased leucorrhœa for two months fluorescence for four months No return up to March 1917

CASE 88 May 1916 Age 45 Menorrhagia frequently for three years anæmia Uterus uniformly enlarged about twice normal size Previous treatment medicinal rest packing cesarean endometrium May 1916 7 milligrams for ten hours June 1916 5 milligrams for fourteen hours Amenorrhœa after first period fluorescence leucorrhœa uterus normal size in three months

CASE 89 May 1916 Age 46 Severe menorrhagia for four years Body of uterus hard and twice normal size Previous treatment curetted twice amputated one year before treatment because of extensive laceration and cystic disease without controlling bleeding May 1916 7 milligrams for sixteen hours Amenorrhœa followed first period usual menopausal symptoms gained eight in good health February 1917

CASE 90 January 1916 Age 47 Severe menorrhagia Uterus uniformly enlarged hard about three times normal size Previous treatment medicinal January 1916 5 milligrams for twelve hours February 1916 77 milligrams Amenorrhœa after six weeks nervousness flushes headache leucorrhœa October 1916 uterus normal in size

CASE 91 August 1916 Age 55 Severe menorrhagia eight and a half pounds asthma Chronic metritis uterus hard enlarged Previous treatment medicinal only owing to eight and a half pounds asthma August 1916 2 milligrams for fourteen hours Amenorrhœa no serious menopausal symptoms October 1916 uterus normal in size

CASE 92 July 1916 Age 43 Menorrhagia for three months history of puerperal infection Uterus about twice normal size Previous treatment curetted without results hyperplastic endometritis July 1916 5 milligrams for fifteen hours Amenorrhœa menopausal symptoms marked at first leucorrhœa for three months no return of flow up to March 1917

CASE 93 July 1916 Age 35 Menorrhagia dysmenorrhœa Uterus about twice normal size Previous treatment curetted cervix repaired without relief X-ray applications for several weeks without result July 1916 5 milligrams for thirteen hours Amenorrhœa leucorrhœa for three months rather trying menopausal symptoms which were relieved by corpus luteum extract

CASE 94 July 1916 Age 51 Menorrhagia for several years had gonorrhea removed ten years before treatment cardiac insufficiency Uterus enlarged and had sensitive to pressure Previous treatment medicinal polypoid endometritis July 1916 52 milligrams for ten hours Amenorrhœa menopausal symptoms which were relieved by corpus luteum extract uterus normal size March 1917

CASE 95 August 1916 Age 30 Menorrhagia severe dysmenorrhœa extreme nervousness profuse leucorrhœa puerperal infection Uterus uniformly enlarged sensitive endometritis Previous treatment right ovary had been removed for cystic change curetted chronic endometritis August 1916 52 milligrams for fourteen hours Amenorrhœa profuse leucorrhœa for three months menopausal symptoms six months later had gained weight and uterus was of normal size

CASE 96 August 1916 Age 45 Nervousness menorrhagia anæmia Uterus enlarged and hard Previous treatment curettage partial amputation of badly lacerated cervix no relief August 1916 52 milligrams for twelve hours Amenorrhœa after ten days leucorrhœa for some time menopausal symptoms rather severe improved by corpus luteum extract

GROUP III—BLEEDING DUE TO MYOMATA

CASE 97 November 1915 Age 40 Severe menorrhagia for ten days each month Thrombosed about 3 centimeters in diameter Previous treatment curettage 148 milligram hours 152 milligram tube Amenorrhœa after one month menses have never returned condition of good health now

CASE 98 December 1915 Age 43 Dysmenorrhœa menorrhagia Severe small fibroid Previous treatment curettage when radium was applied 2000 milligram hours 152 milligram tube Amenorrhœa no return of flow one year later size of good health now

CASE 99 December 1915 Age 43 Menorrhagia for five years dysmenorrhœa Multiple fibroid uterus about size of three months pregnancy

nant uterus Previous treatment curetted to eliminate carcinoma when radium was applied 1800 milligram hours with 50 milligram tube Amenorrhœa April 1916 four months after treatment uterus very little larger than normal size

CASE 76 January 1916 Age 38 Metrorrhagia severe hæmorrhages Multiple fibroid size of six months pregnant uterus history of probable infection Previous treatment patient very stout mitral disease refused operation 1878 milligram hours January 14 1916 and 1878 milligram hours February 3 1916 Patient wrote four months later that she had not improved very much no examination of growth had been made

CASE 78 January 1916 Age 38 Metrorrhagia very stout myocardial changes marked hæmoglobin 20 large tumor Growth size of seven months pregnant uterus Previous treatment rest in bed packing of vagina January 1916 77 milligrams for twenty four hours (1878 milligram hours) same dosage repeated in February 1916 Hæmorrhage ceased promptly patient improved sufficiently to have hysterectomy successfully performed three months later

CASE 81 February 1916 Age 45 Metrorrhagia occasional severe hæmorrhage stout About 5 centimeters in diameter size of growth Previous treatment rest in bed often packed February 1916 77 milligrams for twenty four hours (1878 milligram hours) Prompt cessation after one month no return up to February 1917 December 1916 growth hardly perceptible

CASE 103 May 1916 Age 36 Menorrhagia dysmenorrhœa Growth 5 centimeters in diameter Previous treatment myomectomy curettage May 1916 603 milligram hours 77 milligram tube April 1917 1232 milligram hours Amenorrhœa until January 1917 then had steady bloody stain until second treatment reduced more than one half

CASE 106 May 1916 Age 48 Severe uterine hæmorrhages at intervals for twelve years menorrhagia high blood pressure irregular heart Size of growth about 6 centimeters in diameter Previous treatment curettage packed several times May 1916 600 milligram hours June 1916 700 milligram hours Prompt cessation of flow growth about the size of an olive six months later no return of trouble up to April 1917

CASE 104 November 1914 Age 40 Extreme nervousness before menses menorrhagia Small multiple fibroids Previous treatment curetted twice 1666 hours with 52 milligram tube Amenorrhœa no return to date except one menstrual flow about fifteen months later

CASE 11 September 1914 Age 40 Nervousness menorrhagia for five years dysmenorrhœa Small interstitial fibroid Previous treatment myomectomy 1913 also small polypus removed flow not influenced September 1914 108 hours November 1914 416 hours Amenorrhœa no return to date very much annoyed by flushes

CASE 17 April 1915 Age 40 Metrorrhagia very severe hæmorrhages Interstitial fibroid about 5 centimeters in diameter Previous treatment curetted four times April 1915 936 milligram hours May 1915 1386 milligram hours Bleeding promptly stopped no further menstruation clear discharge for a time June 1916 growth hardly perceptible

CASE 20 July 1915 Age 45 Menorrhagia for eighteen years occasionally metrorrhagia extreme nervousness at periods Size of growth 5 centimeters Previous treatment X ray treatment 20 applications July 1915 1125 milligram hours Prompt cessation of menses no return to date growth one half original size

CASE 25 August 1915 Age 39 Menorrhagia for eight years worse past four years 10 day duration Size of growth 5 centimeters Previous treatment curetted August 1915 580 milligram hours April 1916 menstruated five days now appears for four days but slight tumor decreased two thirds original size

CASE 6 July 1915 Age 43 Menorrhagia occasional severe hæmorrhage Two fibroids (interstitial) largest about 4 centimeters Previous treatment curetted July 1915 520 milligram hours Menstruated once after application no return up to April 1917 uterus almost normal size fibroid hardly palpable

CASE 50 October 1915 Age 35 Metrorrhagia severe dysmenorrhœa Fibroid about 5 centimeters in size Previous treatment rest styptics packing October 1915 580 milligram hours Three months later growth one half original size menstruated two days each month March 1916 menses ceased

CASE 68 December 1915 Age 43 Metrorrhagia for one year dysmenorrhœa Fibroid about 4 centimeters in size Previous treatment rest local treatment 1248 milligram hours with 52 milligram tube Amenorrhœa after three weeks no return up to April 1917 tumor hardly perceptible

CASE 115 June 1916 Age 42 Menorrhagia for ten years often severe hæmorrhages positively declined operation Size of growth about 8 centimeters also right chronic salpingitis Previous treatment curettage 40 X ray exposures which controlled bleeding for only a short time June 1916 700 milligram hours with 50 milligram tube Two weeks later pelvic abscess was drained in vault of vagina amenorrhœa for eight months

CASE 118 June 1916 Age 43 Severe menorrhagia for ten years Growth about 6 centimeters June 1916 924 milligram hours Prompt cessation of menses no return April 1917 severe menopausal symptoms

CASE 143—Age 40 Severe menorrhagia Growth about 6 centimeters August 1916 800 milligram hours Amenorrhœa reduced 50 per cent in four months

CASE 149 September 1916 Age 48 Severe hæmorrhages menorrhagia for many years myocardial disease high blood pressure very stout

marked anemia. Growth about 10 centimeters. Previous treatment rest, curettage. September 1916 123 milligram hours. November 9 1300 milligram hours. Amenorrhea six months later uterus slightly larger than normal size.

CASE 150 August 916 Age 36 Menorrhagia for four years metrorrhagia for three months. Growth about size of three months pregnancy. Previous treatment medicinal rest. August 1916 750 milligram hours. November 1916 600 milligram hours. Amenorrhea her physician reports that she has been relieved. Did not examine growth.

CASE 158 November 1916 Age 46 Severe menorrhagia and dysmenorrhea for three years. Intermittent heart extremely stout. Growth about 20 centimeters. November 5 1916 1694 milligram hours. November 11 1916 924 milligram hours. Four months later uterus no mal size. No tumor palpable. Did not examine growth.

CASE 166 December 1916 Age 36 Severe menorrhagia for eighteen months. Growth about size of three months pregnant uterus. Previous treatment medicinal local treatment curettage. December 1916 1848 milligram hours. December 10 1916 700 milligram hours. March 1917 uterus reduced over one third in size. Small fibroid on posterior wall about same size. Amenorrhea.

CASE 15 March 1915 Age 36 Severe dysmenorrhea menorrhagia pronounced anemia. Bleeding has been pronounced for four years. Extreme nervousness. Size of growth about 3 centimeters. Previous treatment medicinal curetted about two years before treatment no result. May 1915 5 milligrams for twenty-four hours. Amenorrhea for six months since then periods last from three to five days. No clots. Gained weight. Nervousness practically disappeared (April 1917) no examination to determine size of tumor.

CASE 120 June 916 Age 29 Menorrhagia dysmenorrhea. Small interstitial fibroid. Previous treatment medicinal curettage. Radium treatment of 52 milligrams for fifteen hours. Amenorrhea menopausal symptoms marked.

CASE 152 September 1916 Age 41 Menorrhagia for four years metrorrhagia for four months. Extreme anemia (hemoglobin 20 per cent). Uniformly enlarged uterus about size of three months pregnant uterus. Previous treatment medicinal curettage polypoid endometritis. Radium treatment of 77 milligrams for fifteen hours. Was extremely weak for five months afterward owing to severe anemia. Amenorrhea prompt menopausal symptoms mild. April 1917 feels well. Blood picture about normal. No return of menses. Growth reduced one half in size.

A CYSTOSCOPIC STUDY OF THE END-RESULTS OF VARIOUS FORMS OF CYSTOCELE OPERATIONS¹

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Att d g d J S g b W m H p l

DURING the past year and a half a series of studies has been carried on by myself and Doctor Rawls as to the condition of the interior of the urinary bladder in patients who have had some form of cystocele operation.

For the purpose of this study end results only were sought. In securing the end results it was considered necessary that at least one year should have elapsed since operation and examination. With this limitation of time following such operations 150 ward patients constituting the hard working class were asked to return to the hospital for examination. With the approval of the surgeons these patients were taken from the service of every operator in the hospital and can well be said to represent a fair average of the

results obtained by operators who are trained in this character of work. There was no selection of cases all cystoceles and procidentias were taken.

We received responses from some 50 patients or one third of those to whom a summons was sent. The majority of these patients responded to our request apparently from a desire to have us pass judgment on their condition and others on account of not being entirely relieved of the symptoms for which they had been operated on.

Only one patient complained of increased urinary symptoms following her operation. This patient had had an interposition operation. Prior to her operation she had no urinary symptoms. When seen thirteen months later she complained of frequent and painful

micturition The cystoscopic examination gave marked trigonitis with many folds of the trigone The mouths of the ureters could be seen only by holding the cystoscope almost in a vertical position In spite of this bad cystoscopic finding the vaginal examination gave an excellent result

With this exception none of the patients examined stated that any urinary symptoms they might have had were aggravated to the contrary the very large majority stated that they had been in part or entirely relieved of such symptoms This was very striking since only 9 of the 49 patients examined showed a normal bladder base

At the commencement of this study it was our intention to photograph the base of the bladder and procure if possible a composite picture of the end results following different methods of operating During the spring of 1916 I procured for this purpose an excellent wide angle Loewenstein photographic cystoscope The plates as made by Eastman were much more rapid than those of the German make sent with the instrument The pictures procured by Dr Rawls were excellent and we felt that with practice a two piece picture could be made to include the entire base of the bladder The study was discontinued during the summer When resumed in the fall it was found that all the plates on hand had become fogged and we have been unable in spite of persistent effort to have more made on account of the extra thin glass required and the inability of the Eastman Company to obtain this from abroad

This paper for the reason given is of necessity therefore a preliminary report The study will be continued with the aid of the photographic pictures as soon as the needed plates can be obtained

The operations upon the patients examined included in addition to those for cystocele and posterior wall repairs hysterectomies interposition and trisection operations for procidentias also abdominal operations on the uterus and adnexa

For the purpose of this preliminary report twelve (12) patients were found to have a practically normal plane of the base of the bladder Three of these had a mild trigonitis

The character of cystocele operations done upon these patients varied greatly In the larger number the operative procedure consisted in freeing the bladder from the vaginal mucosa and uterus coapting the prevesical fascia under the bladder and approximating the vaginal mucosa after the excess had been removed In a few the operations consisted simply in the separation of the vaginal mucosa on each side of the median incision the removal of the excess and an approximation of the edges under the bladder In one the operation was after the old Emmet method and in one the bladder was anchored on a higher plane to the broad ligaments and uterus after it had been separated from the vaginal mucosa and uterus

In another series of cases the base of the bladder was found to be thrown into horizontal folds of varying degrees of prominence There were 8 patients in this group

In 4 of these there was no displacement of the ureter mouths in the other 4 this displacement was very noticeable The character of operations done in these cases was as follows In 3 after the separation of the bladder from the vaginal mucosa and the uterus the prevesical fascia was united under the bladder the excess of the mucosa was removed and edges coapted In 3 others after the separation of the bladder from the mucosa and the uterus the base of the bladder was anchored by silk sutures higher up on the broad ligament and uterus or to the shelf made by the united broad ligaments if the uterus was removed In one case an oval denudation was made on the anterior wall and the edges coapted

The cystoscopic examination of these 8 patients showed as stated the base of the bladder in each instance to be thrown into horizontal folds of varying depth and extent In some the mouths of the ureters were found displaced in others in addition to the displacement one or both could not be located Trigonitis of a mild degree of the granular or membranous type was the usual accompaniment

The uniform method of putting 300 cubic centimeters of water in the bladder was followed in the entire cystoscopic study

When abnormalities were found as in these and other cases the bladder was distended to its full capacity to determine whether or not the folds would disappear. In no instance was this accomplished. The convolutions and sulci remained as first seen under the 300 cubic centimeters distention showing that they were of a permanent character.

The kind of operation done did not seem to bear in a marked degree upon the character and extent of the permanent folds found to be present. As for instance in Case 14641 the bladder had been separated from the uterus and the vaginal mucosa and the prevesical fascia united underneath. The vaginal examination did not show a perfect end result. The cystoscopic examination showed the bladder mucous membrane thrown into many convolutions. The capillaries of the bladder were dilated throughout the ureter mouths could be seen only by holding the cystoscope in almost a perpendicular position. In Cases 15559 and 14382 the cystocele operations were of the same character as that in the previous patient. The folds of the base of the bladder were present in both yet in a much less degree. The ureter mouths in these instances were easily seen.

Again in Cases 13653 13541 and 13950 the bases of the bladders were attached on higher planes by linen sutures to the shelves formed by the broad ligaments when a hysterectomy was done or to the broad ligaments and uterus if the uterus was retained. In one of these Case 13541 the vaginal examination gave an excellent result yet the interior of the bladder was in a badly folded state. Case 13653 did not show so good an anatomical result yet the base of the bladder was not thrown in as many folds. In Case 13950 the final anatomical result was not altogether satisfactory the cystocele and rectocele had in part returned here the folds in the base of the bladder were at a minimum.

In Case 16371 the patient on whom an oval denudation of the anterior wall was done followed by coaptation of the edges showed a deep sulcus to the left of the trigone with a granular trigonitis.

As an end result in all of the 8 patients under consideration in this group we found

that in 6 there were no urinary symptoms with the remaining 2 the urinary symptoms prior to the operations were improved.

In a third group of patients the folds of the base of the bladders were found to be from side to side (transverse) opposite to the direction of the folds of the bladder bases of those just reviewed. There were also 8 included here.

The convolutions varied in degree and as with the previous group they could not be obliterated by the full distention of the bladder. The character and degree of the convolutions as in the previous cases did not bear any definite relation to the kind of operations done. In 5 of these while the folds varied in character the condition of the base of the bladder was equally bad in all of them. In 3 cases 15160 16462 and 15618 the bladder had been anchored to the broad ligament and uterus on a higher plane. In the other cases 14017 and 15078 the prevesical fascia was united under the bladder after the separation from the vaginal mucosa and the uterus. In the remaining 3 the convolutions were at a minimum yet the operation was of the same character as that done on the two patients before that of suturing the prevesical fascia under the separated bladder.

As in the previous group no vesical irritation that was present could be charged up to the operation. In two the patients were cured of their vesical symptoms. In another two the symptoms were improved. In two others there was no improvement yet the patients stated that they were no worse than before the operations. In one the patient had no symptoms before or after.

The final group of cases brought together are those on whom the uterus was interposed between the bladder and the vaginal layers. Also cases where the uterus was reduced in size by removing a large wedge before interposition.

This class includes 10 patients. As would be expected the bladder base was thrown into a large horizontal fold with deep sulci on one or both sides and also frequently above the fold. The ureter mouths were displaced in every instance and in almost every case one

or both were located with difficulty. In 4 cases one of the uterers could not be found.

Trigonitis with the frequent presence of dilated capillaries throughout the entire bladder mucosa was the rule. In one instance Case 1619₅ this congestion of the base was marked. Micturition was more frequent than before the operation. Here as previously stated the ureter mouths could only be found by holding the cystoscope almost perpendicular to the floor. The vesical symptoms of the patients of this group were as with the previous groups remarkably negative. Seven patients were free from any vesical irritation or frequent urination with one the loss of control before the operation was not relieved. In one there were as stated no symptoms before the operation. Since the operation however she had frequent micturition. This patient had a marked trigonitis.

This detailed review of the study of the end results on these patients from the view point of the anatomical condition in which the base of the bladder is left is not of a flattering character. That the abnormal conditions found were of a permanent character cannot be questioned since they did not disappear under full distention.

Operators have not as far as I know given the condition of the interior of the bladder any consideration in cystocele operations. Our whole thought has been centered on restoring the anterior vaginal wall to an apparently normal state by such a character of operation as would insure a permanent result. The bladder interior is a remarkably tolerant organ and seems to require bacterial infection before symptoms result. This fact has been long recognized and is accentuated by this study. In the entire number of patients examined only two were found to have vesical symptoms as a sequel to the operation. To the contrary with many the frequency of urination complained of before operation was either improved or cured as a result of the operation.

However the fact remains that with our prevailing methods of repairing cystocele and operating for procidentia the base of the bladder as seen through the cystoscope

is in the majority of instances thrown into folds and sulci.

The query naturally presents itself that although apparently there is no disturbance as a result of this departure from the normal plane like floor does not such a state render more possible some future disturbance of a systemic character?

The downward peristalsis of the ureters with the valve like action of the mouths are recognized. In the presence however of displacements and fixation of a part of the vesical portion of these ducts buried as in many instances among the artificial folds it is not inconceivable that the final result may be far reaching in disturbing the general health of the patient. This can only be a belief yet I think a legitimate one. The truth of such a possibility cannot from the nature of the condition be determined except by painstaking investigation of each individual patient over a long period of years. This is hardly possible from the nomadic character of the average hospital patient. The departure however from the normal plane of the trigone with its interference with the complete emptying of the bladder as is the case in some instances must predispose to bacterial infection with its resulting symptoms and sequelæ.

As seen from a study of these patients the kind of operations done did not appear to have any connection with the extent of the distortion of the base of the bladder. In anchoring the bladder base to a higher plane with sutures attaching it to the broad ligament proportionately as many abnormalities were produced as by the other method of having the bladder free after its separation from the uterus and bringing together the tissues underneath it. In these patients when the bladder base was found free of convolutions operations of the same general character were done as in those having convolutions.

The degree of the cystocele found at the first examination has never been noted in the history of the patient the single word cystocele covering an extensive prolapse of the anterior wall as also one of a very mild character.

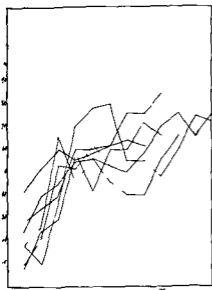


Fig. 4

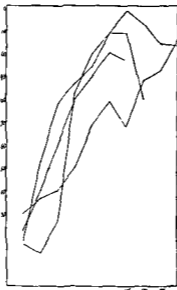


Fig. 5

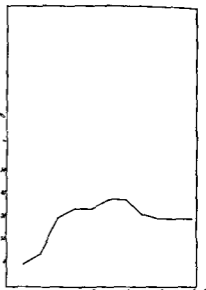


Fig. 6

operations that no lesion of any kind existed either in the stomach or duodenum

The special points which characterize these normal cases are

1 There is no fasting contents or at most the fasting contents consist of a few (10 to 20 cc) cubic centimeters. This is mostly mucus more rarely a thin watery fluid and very rarely is bile tinged. It usually contains no or very little free hydrochloric acid and shows a low total acidity. Frequently however there is no acid content whatever.

2 Hydrochloric acid is secreted rapidly and the total concentration rises and reaches its maximum usually at approximately the end of the first hour.

3 Thereafter the total concentration of acid tends to fall and approach the level from which it began.

4 The stomach is empty after this test meal at from 10 to 135 minutes after ingestion. Thereafter the stomach contents resembles the original fasting contents.

It has previously been taught that the total acid concentration in the stomach is a constant phenomenon and in humans usually averages about 0.2 per cent. Even a short experience with the fractional method of making stomach examinations negatives such impressions. The true conception seems to be

that the concentration of acid in the stomach contents is a variable factor and depends on the chemical character and amount of the stomach contents. The degree of concentration is variable also during the digestive period and normally the latter is characterized by a primary rise followed by a secondary fall in the acid content. With carbohydrate meals it is common experience to see the acid content mount to 0.4 per cent and 0.5 per cent and with proteid (meat) meals to figures much higher than that.

The fractional method is especially valuable in furnishing this truer conception of the acid concentration in the stomach contents. Under the older methods estimations are made at the end of an arbitrarily chosen time usually at the end of an hour. With the fractional method it is frequently demonstrated however that the highest concentration is reached at a much earlier or later period of digestion and in pathological cases this may be as late as at the end of three or four hours.

The number of cases of ulcer of the stomach or duodenum which have been studied is to date sixty three. In the majority of the cases the studies are complete observations having been made both before and after operation. In a few some of the observations are lacking, either those which should

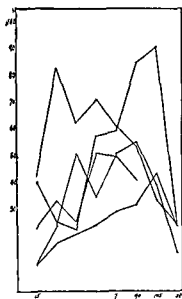


Fig. 7

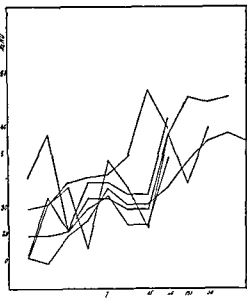


Fig. 8

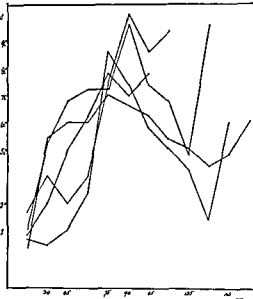


Fig. 9

have been made before or those which should have been made after operation. The number of cases cited in each of the groups described hereafter furnishes a roughly accurate index of the relative proportions of the various disturbances actually existing among all of our cases.

ANTE OPERATIVE STUDIES

The observations made before operation of the pathological variations of the secretory function can be classified into groups the individual members of each group showing marked similarities. These groups are as follows:

1. A number of the cases show no disturbance in the function of hydrochloric acid secretion and are practically identical with those described as the normal controls. These were all cases of duodenal ulcer. The duration of symptoms in these patients was from two to six years (Fig. 2).

2. The digestive period has normal characteristics with the one exception that the period was appreciably prolonged beyond the normal length. Of the two cases cited one had had symptoms for three months and the operation demonstrated a healed ulcer with a resultant pyloric stenosis. The other had an open ulcer on the lesser curvature and had had symptoms for eleven months (Fig. 3).

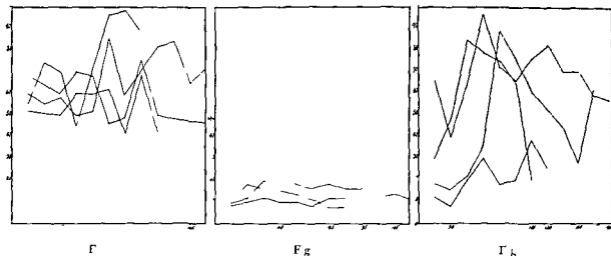
3. This is much the largest group. At the beginning of digestion the acid content is

usually low and as digestion proceeds there is a progressive increase toward a moderately high total concentration. The secondary fall usually seen in the normal cases is missing and the stomach is emptied when its contents still have an excessive amount of acid. The length of the period varies between 120 and 180 minutes, the average being between 140 and 150 minutes.

Five of the cases cited had had symptoms for one to eight years and at operation were found to have open duodenal ulcers. Two had had symptoms eighteen months and three years respectively and at operation large open ulcerations in the duodenum were close enough to the pyloric ring to form a source of obstruction. In the remaining two the ulceration had healed and stenosis had resulted. Symptoms were present for two and sixteen years respectively (Fig. 4).

4. The observations in these patients show marked exaggerations of the disturbance characteristic of the preceding group. The rise is progressive, rapid and very steep. The stomach is emptied sometimes appreciably before the normal time, more often at approximately normal times and the total concentration of acid at that moment is altogether too high (Fig. 5).

Three of the patients had open duodenal ulcers and the symptoms had existed for eight months to six years. The fourth had



a pyloric stenosis and there had been symptoms for two years

5 The subacidity cases of ulcer are relatively few in number. The ulcer in the case studied was on the lesser curvature was moderately large and had given symptoms for five years (Fig 6)

DISCUSSION

The fundamental facts elicited from these studies are as follows

1 Ulcerating lesions in the stomach or duodenum are not necessarily accompanied with disturbances in the normal physiology of acid secretion

2 The situation of the lesion bears no relation to the disturbance if any exists nor to its character or intensity

3 The disturbance bears no relation to the character and size of the ulceration present nor to any complicating anatomical condition such as a stenosis which may be present

4 The time factor bears no relation either to the disturbance in physiology or to its intensity

5 The amount of physiologic disturbance bears no relation to the character and intensity of the subjective complaints

The time factor which necessarily enters as an important item in this discussion is one

which is not possible of mathematical precision inasmuch as in this disease it depends altogether on the statement of the patient which in turn is based on subjective symptoms. This necessarily gives knowledge only of the length of time for which there have been symptoms and not of the length of time for which the lesion had actually existed. It does not give any information as to whether all of the symptoms for all of the time had been due to an anatomical lesion or at the beginning to some neurogenous disturbance of physiologic function. Nor can we determine whether any other lesion either close by as in the gall bladder or at a distance as in the appendix had not co existed for part or all of the time and had accounted for part or all of the subjective symptoms.

There is no rule therefore which governs the amount of physiologic disturbance of acid secretion of the stomach and every case becomes a law unto itself. Every case deserves intensive study with the object of determining the relation of the subjective symptoms to the physiologic disturbance and to the actual lesion present and the relative value of each of the latter two elements in the causation of the patient's symptoms.

POSTOPERATIVE STUDIES

Most of the observations were made within three months after operation the greatest majority between the fourth and the eleventh

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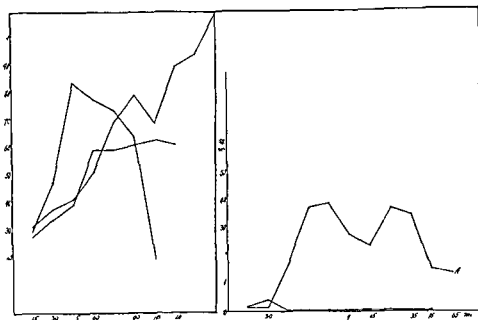


Fig. 13

week. They include all kinds of cases—cases of ulcer of the stomach in its various usual locations as well as ulcer of the duodenum.

The operations which are employed on this service are as follows:

1. Excision of the ulcer bearing area

Excision of the ulcer bearing area by resection in continuity of the middle segment of the stomach (sleeve resection).

3. Gastrojejunostomy by suture or Murphy button with and without exclusion of the ulcer bearing area by the string method

4. Excision of the ulcer bearing area by pylorotomy or partial gastrectomy with the necessary gastrojejunostomy made practically always by Murphy button

The test meals were all given after the manner previously described. In several of the control cases observations were made after the exploratory operations. At these operations the stomach and its neighboring attached structures were withdrawn from the abdomen through a median incision and were handled in the manner necessary for determining the presence of an ulcer or any of its complications. No exploratory gastrotomy was made. No ulcer having been found the parts were returned into the abdominal cavity and the external wound was closed. In studying the postoperative observations in the cases no appreciable difference could

be distinguished from those made before operation.

In the cases in which ulcers were found the postoperative observations were classified and resulted in the following groups:

1. Cases in which the acid secretion responded to what we have recognized as the normal type.

In several of the instances the total concentration was rather high but except for that these too showed normal characteristics (Fig. 7). The individual specimens may or may not be bile stained.

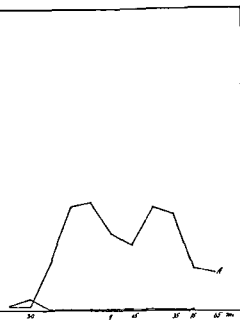
2. Cases in which the total acid concentration begins at or near the normal base line and then rises slowly to a moderate degree.

The secondary fall is not present. The digestive period is between 120 and 180 minutes long, the average being between 140 and 150 minutes. The individual specimens are usually all bile stained (Fig. 8).

3. The amount of acid in the fasting content is usually low and as digestion proceeds it rises rapidly and reaches a high total maximum between seventy-five and ninety minutes after ingestion.

Then in many of the cases there is a steep and rapid fall due to a large influx of duodenal and small intestinal contents which is again followed by a steep rise. At the time of complete emptying the gastric contents contains a large amount of acid much larger than is normal. The indi-

Fig. 14



vidual specimens are practically always bile stained and the digestive period averages between 105 and 150 minutes (Fig 9)

In a number of the cases it was found that the fasting content contained a large amount of acid and when food was introduced into the stomach the total concentration tended to remain either at approximately the same level or to go to even higher levels. At the terminal stage there was just as much acid in the gastric contents as at the beginning. In one of the cases there was an appreciable fall at the end of digestion. The specimens were usually all bile stained. The length of the digestive period was between 120 and 180 minutes (Fig 10)

5 The postoperative subacidity cases are few in number. They usually begin with a small amount of acid and run an even level throughout digestion. The specimens are usually bile stained. The length of the period averages about 130 minutes (Fig 11)

In several of the cases we were able to repeat the observations a number of times at widely separated intervals after the discharge of the patient from the hospital. One of these cases is herewith described as an illustration of the sequence of events.

Hospital No 160857. The ante operative study is shown in Figure 12. 1. Under our classification this must be considered as a normal observation. At the operation a duodenal ulcer was found and for its cure a posterior gastrojejunostomy was made by suture and the ulcer bearing area was excluded by the string method.

The first postoperative observation was made twenty two days after operation and is shown in Figure 1. B. This shows a marked lessening of the total acid concentration with a progressive rise from the beginning to the end of digestion. During the following year the condition of this function was investigated on two separate occasions and the result are shown in Figure 1. C and D.

DISCUSSION

The demonstration of a normal acid function after operation and its persistence has been found to occur most frequently in cases of acutely perforating ulcer of the stomach or

duodenum.¹ There is much reason for the belief that the mechanism of acute perforation of the stomach or duodenum is in the greatest majority of the cases analogous to acute perforation of the appendix. If this premise be true it follows that physiological disturbances need not necessarily have occurred concomitantly with the perforation which then assumes the rôle of a mechanical lesion. The nature of the lesion makes an immediate operation imperative and when recovery takes place it does so quickly. No disturbance need therefore be looked for after operation and this conclusion is borne out by the clinical facts.

The cases which give the largest number of similar observations are those grouped as moderate or excessive hyperacidities. These conditions are usually seen to follow similar ante operative conditions. The usual sequence is for the total concentration to be appreciably lowered after operation without the curve in any way losing the general characteristics of the observation made before operation. This immediate fall has however very frequently been followed after a longer or shorter interval by a return to the pre operative status. In a number of the cases the final postoperative acidity has exceeded that existing before operation (Fig 12).

It is not however universally true that the postoperative hyperacidities follow similar ante operative conditions and among the numerous cases which have been studied it was found that a postoperative moderate or excessive hyperacidity may follow any of the types noted in Figure 13.

This change in the postoperative hyperacidity cases is probably entirely due to the effect of the alkali introduced into the stomach through the anastomotic stoma (duodenal content). This produces an immediate fall in the total acid concentration of the stomach contents. Following physiological law the chemical neutralization acts as a stimulus to a renewed and much increased formation of acid and finally the total content returns to its previous status or to conditions in which it may be increased even beyond the latter

The postoperative subacidity cases followed similar ante operative conditions. It has been the usual experience that when once a condition of subacidity has appeared it remains at that level or falls to even lower concentrations.

The nature of the operation employed seemed to have no relation to the postoperative changes in the acid secretion with the exception of those operations in which it is necessary to remove a larger or smaller segment of the pyloric part of the stomach. In several instances it was found that a condition of anacidity followed the latter type of operation (Fig 14). It is difficult to understand this change inasmuch as the acid secreting cells are at a minimum in the resected part of the stomach.

CONCLUSIONS

The dominant features of the postoperative studies are as follows:

1 A normal secretion follows most frequently operations for acutely perforated ulcers.

2 An ante operative subacidity usually persists after operation.

3 There is no rule which governs the sequence of events in the majority of the cases of postoperative moderate and extreme degrees of hyperacidity.

4 Resection of the stomach may be followed by conditions of anacidity.

COMMENT

It is difficult to understand in any individual case the relation of the postoperative clinical facts to the laboratory examinations noted in this communication. For it is found that subjective cures may be obtained when the laboratory examinations indicate a disturbed physiology and postoperative symptoms may appear when the disturbance of secretion seems to be improving or when the secretion is within normal limits. This is probably due to the following facts:

1 The symptoms need not necessarily be due to the disturbance of acid secretion but to the disturbance of some other function of the stomach.

2 The symptom may be pain which is due to an ulcer which has not yet undergone healing or perhaps to some entirely different lesion.⁽²⁾

3 The ante operative suffering may have been so marked that the relief obtained by operation overshadows completely any slight subjective complaint which may persist or appear.

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PERINEAL HERNIA

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 and S. M. S. Hooper, M.D., F.A.C.S., Chicago, Ill.

IN previous studies upon the pathogenesis of hernia I have emphasized the fact that every hernia results primarily from a defect in the intra abdominal or pelvic fascia which in turn is caused by the passage of either a blood vessel or a viscus out of the abdomen. It is somewhat surprising that hernia at the outlet of the pelvis is an occurrence of such extreme rarity. When we consider that the urethra, rectum and vagina and a host of blood vessels pass in and out of the pelvis it seems strange that pelvic hernia are not more common than they are. Indeed after a careful search of the literature going as far back as the 18th century I have been able to find only 8 cases of perineal hernia reported. In order to obviate all possible argument upon this point I may mention here that the term perineal hernia as used in medical literature is somewhat of a misnomer because most writers include under this generic name not only those hernia which make their exit in the perineum or in close proximity to it but also all the hernia which escape from the abdomen at the pelvic outlet. The only hernia which apparently has escaped such a generalization is the sciatic hernia and if we consider that so few of this particular variety have been observed either at operation or at autopsy and also that clinically the differential diagnosis is so extremely difficult it appears to me to be not unlikely that one or another of the cases reported as sciatic hernia belongs in reality to the perineal group and vice versa.

The inadequate observation or more charitably said the inadequate description of many of the 28 reported cases has made it necessary for me to follow the footsteps of the majority of my predecessors in this field namely to accept the statements of the various writer regarding the particular nature of the hernia at its face value. As far as it lay in my power I have traced all

cases to their original source of publication and as a result of this study I am compelled to confess that the evidence in some cases hangs by a very slender thread so slender indeed as frequently to give rise to the temptation to exclude a large number. I refrained from so doing merely because I realized the difficulties which surround the entire subject. The mixup is caused principally by the fact that the greater majority (20) of the cases reported are merely clinical observations that very few case only (4) were operated upon and that only a very small minority (4) were examined post mortem. By this statement I mean to imply that in order to determine the exact pathological condition of a perineal hernia a clinical observation while very valuable is not at all sufficient. Even an operation cannot be said to be entirely sufficient as it does not as a rule offer the opportunity to study the detailed anatomy with that amount of care which appears to be requisite. There finally remains only the third method of study, namely postmortem dissection which after all is the only method that can be considered ideal. The difficulty however is that with the exception of Scarpa's classic case no case has been dissected with the requisite amount of care to be beyond doubt.

Last winter through a fortunate circumstance a case of perineal hernia was referred to me for operation. This case forms the basis of this paper.

Esther P. age 2 years as referred to me by Doctor Schwartz of Fall River, Massachusetts. Six or seven weeks before being seen by me the mother noticed a swelling in the right buttock. This swelling increased slightly in size during the following few weeks but apparently it was not the cause of any discomfort.

Physical examination revealed the following: There was present in the right buttock a moderately firm very movable swelling which occupied roughly speaking the region bounded medially by the coccyx and anus and laterally by the tuberosity of the ischium and the gluteus maximus. The pal-

pable surface of the mass was globular and increased in size when the child cried. On manipulation the mass escaped in an upward direction but it never disappeared entirely. The tumor caused a notable fullness of the buttock unfortunately however my photographs are not good enough for reproduction. Rectal examination revealed a mass upon its right when an attempt was made to reduce the mass the palpating finger noted that the rectal fullness increased in volume. It was impossible to determine by examination whether the hernia for such it was taken to be was reduced through the sciatic notch or through a hiatus in the levator ani.

I was somewhat at a loss to account for the fact that no matter what the manipulation or how frequently attempted the hernia could not be reduced completely. Finally I arrived at the conclusion that either there existed a subperitoneal lipoma in connection with the hernia or that the contents were adherent to the fundus of the sac. As will be seen the former diagnosis proved to be correct.

Two methods of approach were considered namely the abdominal and the perineal on account of the possibility of the presence of a large subperitoneal lipoma. I finally decided in favor of the latter. The operation was carried out on May 23 1916.

With the patient in the prone position and with the buttocks elevated an oblique incision about three inches in length was carried over the tumor in the right buttock. On reaching the ischio-rectal fossa I encountered a long lipomatous mass distinctly encapsulated leading upward into the depth of the wound. At its basal attachment it had to be separated from the underlying peritoneum by sharp dissection. When this was finally accomplished a defect in the pelvic floor was found through which two fingers could be introduced into the abdomen as high as the pelvic brim. The finger entered through the posterior part of the levator ani approximately just anterior to the coccygeus. On increasing the intra abdominal pressure a hernial sac was seen to descend through this hiatus. This sac was not opened nor resected however as it was recognized to be too intimately adherent posteriorly to the rectum and anteriorly to the vagina (*hernie par glissement*). The opening in the depth of the pelvic floor was then closed by interrupted chromicized catgut sutures and was reinforced by liberating the gluteus maximus and suturing its inferior margin to the deep pelvic fascia.

The specimen removed proved to be a lipomatous mass six inches long and two inches wide. A small portion of the peritoneal sac was adherent at its deepest attachment and was proved to be such on microscopic examination. After primary union of the wound the patient was discharged June 9 1916.

There does not exist in my mind the slightest doubt as to the correctness of the diagnosis of a perineal hernia and yet I

confess that I have not brought forward such proof that the diagnosis may be said to be beyond any doubt. In extenuation I plead that because of the smallness of the parts involved the youth of the patient and the lack of necessity for a more careful dissection complete proof was not possible.

From as much information as I could gain from the operation it appeared to me that the hernia made its exit at the seat of predilection for these herniae namely at the posterior border of the levator ani or better said through the very frequent cleft between the levator ani and the coccygeus and that subsequently the hernia burrowed a way for itself into the ischio-rectal fossa. In this respect it corresponds to the picture of the classical perineal hernia if such can be said to exist. The lipoma which accompanied the hernia is not at all an infrequent occurrence in perineal hernia. The patient was presented at a meeting of the New York Surgical Society March 14 1917 thus far the cure appears to be radical.

As far as my studies indicate only two operations have been recorded for indubitable cases of perineal hernia.

CASE 1. Reported by Bottini (1). The patient was a female 33 years of age the hernia was located upon the left side was of the size of a coconut and perfectly reducible. Bottini operated through a vertical incision parallel with the ascending ramus of the ischium (In other words the incision was not unlike the one used by me). The hernial contents were recognized as small intestine sigmoid flexure the left tube and ovary. The hernial sac was extirpated and the wound closed in layers with catgut. The wound became infected. At the time of her discharge from the hospital there was no recurrence.

CASE 2. Reported by Thomas (2). The patient was a male 6 years of age who four years previously after lifting a heavy weight noticed a rupture in the anal region. The hernia gradually increased in size up to a year ago since which time it has remained stationary. It caused a great deal of difficulty in walking and sitting and also during defecation bladder symptoms were absent. When first seen by Thomas the swelling extended as far as the posterior extremity of the scrotum. The posterior part of the hernia was reducible and evidently contained intestine the greater part of the hernia however was irreducible firm elastic and dull on percussion. At the operation which was performed in the lithotomy position a fibromyoma weighing

2/ pounds as e tirpated. Se e al burse were present upon ts surface. Th patient was greatly relieved by this operation though apparently (?) nothing as done for the hernia and at the time of his dscha ge the e ere still pres nt the physical signs of a hern a such as bulging on cough ng etc.

While not proved bev nd doubt I am inclined to accept as sufficiently suggestive to be included n my li t of operat e pe ineal hernæ the following two cases. Th y diffe from the p e ious cas s by the fact that they were merge v perat on for an intestinal obstruct on and that th refore no attempt c ld be m de to subject the patient to more c reful study. Pract cally all that was done was to in se the ac of the h ia the c nents of v h ch were stra gulated bowel.

CASE 3. R ported by Harrison (3). The pat ent gave a hsto y that for three months he had been compl nng f an inten e bu ning p n in the per neum acc mpanied by n alm t constant m c tur tion h ch he attr buted to exce si e horseback riding. Th sesymptom suddenly d appeared when the pat ent notic d a small t mor in that locality. Wh n Harr on e amined the pat ent he found a hard tumor about th s e of ha elnut just b him l th c otum and in conta t with the bulb of the u tl a. The tumor c ntinued to increase in s a d f lly en ro cl d upon the scrotum. Th patient a nst s n by Ha ri on May th. By June 3 the symptoms bec me ageravat d the scrotum wa greatly e larg d and very painful there vere ecurring chills th fe r. I c sion of the scr tum on June 4 va follo d by a discha ge of pus and ve y offens e fe ulent matter. Th ec day later th as d cha ged th h the ound alo p of ga c u test nss hes long. Th wou d v a c mplet ly h aled 35 days.

Epicrisis. Absolute proof is lacking that this was a true case of perineal hernia however the presumption i strong that it was such because we find it distinctly stated in the history that the hernia br t made its appearance in the perineum and only gradu ally extended toward the scrotum. The fortunate outcome of the case should also be commented upon.

For similar reasons I am also inclined to include among the proved cases the following

CASE 4. Reported by Stiegele (4). The he n a occurred i a male nd vidu l 3 ve s of age ho had s ed f number of years in th artill ry. On d y h sudd nly s d with g png p n in the abdom n v h h er p ticularly vere in th ght half f tle hypogastr egion. The p ns per ted en fter a evacuation of th bo els an l examinaton a perineal h ma s f und. With the e ptu n of sm l l p of int st ne mo t f the he n l ont t er s ly educ d

The pain and the vomiting persisted unt l the follow ng day v hen Stiegele was asked to see the pat ent. Again attempts at reduction were made and these being ineffectual the patient was operated upon. In the lithotomy pos tion a median incision v as made just to the left of the raphe. A hernia was encountered conta nng strangulated but viable gut v hch was reduced by manipulation. The pain ceased at once and v as followed by stool. The pat ent was finally cured.

The four cases just enumerated are the only true cases of perineal hernia that I find recorded in the literature as having been operated upon making a total of five cases including my own. For the sake of completeness I wish to mention in brief also the following two cases which have been reported as cases operated upon for perineal hernia but which for one reason or another as is stated in the history I have deemed proper to exclude.

CASE 1. Atkinson (5) reports a case with the title An Unusual Form of Perineal Hernia. The patient was a prem tu e female infant three weeks old. Nothing abno mal was noticed up to the date of dmission to the hospital when a large bleedin mass was found protruding f om the vulva between the labia. This mass as rreducible and about inches n length nd one inch n d amet r nd had short thick p dicle. The mass projected ba k ard co er ng the vagin l orifice a d anus. On ele ating th mass it was found that the vag n was unobstru ted and th t the pedicle emerged from the u ethral orifice. A p obe could be passed n front of the mass into th bladder for about t o inches.

The ope ation which was ca ried out on the day of adm sion is much to my regret very inadequat ly described. As near as I can gather from the descript on the m ss was ncised and this c sion immediately opened nto the peritoneum with the es p of a little fluid. The neck of the p ot usion was then ligated and the mass removed the stump ret acted into the u th a. Uneventf l r o ery follo ed.

Micro c p acunation of the specimen showed an outer l yer of st ated epithelium der d from the bl dde o urethra an ntern l endo thetal layer p s mably p rto um nd a lay r f mouth mus l fb nd n ct tssue bet n th t o.

Epicrisis. Judging entirely by the description of the case I am inclined to exclude this case from the true perineal herniæ. It appears to me most probable that the case is one of a true prolapse of the bladder throu h

the urethra the microscopical examination stamps it as such and to my mind it does not require any further discussion

CASE 2 Bromfield (6) relates the history of a boy upon whom he operated for stone by perineal section During the operation the small intestines prolapsed into the wound These were reduced and in spite of the gravity of the case particularly in the pre antiseptic era recovery ensued

Bromfield assumes and is supported in this assumption by Sir Astley Cooper that an incomplete perineal hernia existed between the bladder and the rectum which was injured during the operation

Epicrisis I am inclined to exclude this case as a true perineal hernia Accidental injuries of the peritoneum may occur in the course of any perineal section and I am sure that everyone will agree with me that hardly sufficient opportunity is given to study the relations of the parts in question through the small incision in the perineum

Just as many cases of postmortem observation as of operations are recorded in the literature However even many of these are not observed with that requisite amount of care as to be available for the purpose of study Fortunately for us one of these cases was observed and studied by Scarpa and he describes his case with such extraordinarily fine detail and masterful skill as to stand as a model for all future observers The case is the following

CASE 1 Scarpa (7) The patient was a male individual 59 years of age and apparently afflicted with pulmonary tuberculosis A few years before consulting Scarpa the patient while standing astride a small brook with legs widely separated and the body bent forward suddenly felt an acute pain in the right buttock as if something had been torn apart Upon resuming the erect posture he discovered in the vicinity of the rectum a small lump the size of a walnut On slight pressure this lump disappeared in the depth Subsequently the patient was able to prevent the prolapse of this mass by a bandage A violent cough which ensued and lasted four months increased the size of the mass until it reached that of an egg

Subsequently the patient sought relief through Scarpa and desired some kind of a supporting truss On examination there was to be seen in close proximity to the right margin of the anus and extending to the gluteus maximus a pear shaped mass the size of an egg which gave an impulse on coughing the contents were reducible with a gurgling sound

Nine years later the patient was suddenly seized with pain in the abdomen extending from the pelvis to the umbilical region it was accompanied by dysuria and nausea and was soon followed by vomiting and distention of the abdomen The hernia had greatly increased in size and was very tense and tender On admission to the hospital an intestinal obstruction was diagnosed Under conservative treatment the obstruction was relieved with cessation of all the symptoms A few months later the patient died from a progressive pulmonary tuberculosis

A very careful dissection was made of the hernia and revealed the following On opening the abdomen nothing abnormal was seen at first When the terminal portion of the ileum was lifted up it was noted that it was evidently pulled up from a depth much greater than is normal When viewed from within the abdomen it was seen that the right half of the pelvis was much deeper than the left In the depth of the right half there was to be seen also an opening through which the peritoneum was continued to still greater depths The opening which was evidently a hernial ring measured approximately one inch in diameter All the pelvic viscera were pushed over toward the left

The skin covering the perineum was not adherent to the deep structures Directly underneath the cellular fascia there were to be seen fibers of the levator ani the fibers were thinnest upon the top and increased in thickness upon approaching the ring Careful examination showed that the hernia first emerged behind the transversus perinei and was therefore located in the space bounded by the right margin of the anus the greater sacrosacral ligament and the tip of coccyx As the hernia increased in size it pushed the rectum over toward the left side Underneath the levator ani there was the hernial sac the hernial contents were as before stated a loop of ileum

But for the slight difference that my case was complicated by the presence of a lipoma upon the surface of the hernia it appears to be practically identical with that of Scarpa

Other cases of perineal hernia that were studied at autopsy which I find recorded in literature are the following

CASE Chardenon (8) observed the following case in 1740 He dissected the body of a male individual 45 years of age who died of some acute illness which is not otherwise mentioned As he was removing the small intestines out of the pelvis he felt a resistance which was looked upon as being caused by an adhesion On close examination however he saw that the ileum disappeared between the bladder and the rectum On exerting a more forcible pull the intestine suddenly came away and it was then seen that instead of the presumed adhesion a

hernia sac the size of a pigeon's egg, as presented. The mouth of the sac had a diameter only one third as large as the fundus and had a hard callous margin. With one finger in the sac and another upon the perineum it could be ascertained that only the tegumentary structures entered.

This case was evidently the first case of a perineal hernia observed in the male. Its description is so precise that the diagnosis of a perineal hernia cannot be doubted. This case forms a rather important milestone because the existence of a perineal hernia in the male had been denied up to that time by the best observers, even by Chopart and by Desault.

CASE 3. Cooper (6) found that tops of the anal body, long perianal pouch between the bladder and the rectum. The distal extremity of the pouch however did not each quite to the skin and therefore the hernia did not cause a swelling palpable superficially. Cooper looked upon this case as one of an incomplete perineal hernia, not that he was of the opinion (and possibly he knew) that all cases of perianal hernia are incomplete.

CASE 4. Iapen (1) and the title *De Si per d. H. a. Do sal* elated a most remarkable case which is probably a giant perineal hernia. It is the record of an uterine hernia which appeared on the body of a female of age 50 who died suddenly. There was a swelling in the right side of the anus, the calves of the legs. The contents of the entire small intestine, caecum and the appendix, the stomach, pylorus and duodenum were adherent to the neck of the hernia. The neck of the hernia was bloody and located between the anus and the coccyx.

The hernia had extended for many years and during this time had reached the colossal size of a woman's head.

In Jacobsohn's (11) article *Ueber den Mittelfleischbruch* I found a reference to the following records of autopsies which for valid reasons I deemed it proper to exclude. It should be added however that I was unable to verify the cases by looking up the original publications. They are the following. The case of Bose (1) was apparently one of sciatic hernia. The case reported by Hartman (13) was very probably a case of a pudendal hernia, a hernia closely allied to but still not *sensu strictu* a perineal hernia.

The rarity of perineal hernia and the number of its possible varieties make it incumbent upon us to be circumspect in the acceptance

of cases. It is particularly on that account that I have emphasized the fact that in the first line only well observed autopsy records should be accepted as incontrovertible proof. Next in line are carefully observed operative cases and in the third line only clinical observations without either of the preceding. For the sake of completeness however I have decided to add a brief abstract of the acceptable cases as I find them recorded up to the date of this writing. They are the following.

CASE. Berger (14) mentions casually a case that is probably a case of perineal hernia, the description of the case however too insufficient.

CASE. Fischer (15) reports the following case. The patient, a male individual, 46 years of age, had been complaining since a few months of a peculiar pressure behind the cranium and which was particularly annoying after arduous work. On examination Fischer found a small reducible swelling in the perineum. The hernia was looked upon as a hernia Truss treatment.

CASE 3. Hager (16) reports the case of a patient, a male, 3 years of age, who during an attempt at lifting a box, eight inches high, the legs widely separated, suddenly felt a severe pain in the perineum followed by the appearance of a swelling to the left of the rectum. This swelling increased in size very rapidly and when first seen by Hager measured 6.8 inches. Subsequently the left labium also became involved but as it was separated from the swelling which first appeared by a depression which was looked upon by the author as the transverse perineal. The hernial ring, stated to have been bounded by the tuberosity and ascending ramus of the ischium, the coccyx and the os coccygis. The hernia was considered to be incurable and the patient was treated only palliatively with a huge suppository.

CASE 4. Hayden (17) reports the title *A R. R. Case of Perineal Hernia* the following case. The patient was female, 3 years of age. During confinement a small firm tumor appeared in the vagina which was looked upon as a polypus. Six weeks later it had increased in size and diagnosis of a perineal hernia which had descended on the right side between the rectum and the vagina. It was reduced with considerable difficulty and sustained by a truss.

CASE 5. Henno (18) reports a case of a soldier, 3 years of age, who fell from a considerable height and struck the perineum. Four or five days later he noticed a swelling located between the tuberosity of the ischium and the anus which gradually increased in size. The swelling was elastic andducible and became larger on straining and coughing. By a process of elimination he arrived at the diagnosis of perineal hernia. The hernia however was not proved definitely.

Jacobsohn (19) reports the following three cases

CASE 6 The patient was a male individual 20 years of age. The hernia the size of an egg was caused by a fall upon the perineum. It was most prominent in the middle of the perineum just in front of the rectum. It could be easily reduced in fact it disappeared in the recumbent posture. It increased in size on coughing and straining. The patient wore a T bandage for a long time and held the hernia reduced by it. After a while it disappeared completely and there remained only an empty cutaneous bag.

CASE 7 The patient was a male 35 years of age. One and one half years before being admitted to the hospital the patient fell through an opening in the floor of a barn from a considerable height. He struck on the rung of a ladder directly upon the perineum. The scrotum was torn open and the urethra was also injured. The accident was followed by urinary retention. Attempts to pass a catheter were unsuccessful at first but subsequently the patient began to urinate in the course of time but the ischuria persisted. Five weeks prior to his admission to the hospital the patient noticed for the first time a small soft swelling in the perineum which greatly increased in size. On examination there was found on the left side of the perineum an ovoid swelling which was easily reduced but reappeared immediately on releasing the pressure. On tracing the swelling upward it was found to disappear through an opening in the perineum which admitted a finger. The hernia evidently contained the bladder as urine could be voided only after manual reposition of the hernia. Truss treatment was followed by a slight improvement in the symptoms.

CASE 8 Female 4 years of age. After a precipitate labor the patient noticed to the right of the anus a swelling the size of a pea. The patient was also suffering from tuberculosis. Owing to the continuous cough the perineal swelling rapidly increased in size so that it subsequently involved also the vagina. On examination there was found a ball like protrusion having a diameter of about two inches. It was located on the right side beneath the gluteus maximus between the anus the tuberosity of the ischium and the tip of the coccyx. It was reducible with a gurgling sound through an opening with resistant edges and about one inch in diameter.

CASE 9 Koch (20) reports the following case. The patient was a male 50 years of age who had a huge hernia reaching in the recumbent posture down to the knees. The hernia had existed for many years was always reducible up to the time when first seen by Koch when it was in a condition of strangulation but was reduced by taxis. The bladder formed part of the hernial contents 4 1/2 pints of urine being obtained by catheterization after partial reduction of the hernia. Subsequently the patient died of a second strangulation unfortunately no autopsy was obtained.

CASE 10 Masse (21) reports the following case. The patient was a female 30 years of age who had a hernia attached to the right half of the perineum that was so large and pendulous that it reached the popliteal space. It was only partially reducible the lowermost irreducible portion was looked upon as a lipoma. The case is additionally interesting from the fact that when first seen the patient was a primipara and eight months pregnant the subsequent delivery was normal. Patient refused operation and was discharged with a truss.

CASE 11 McGavin (2) presented before the Section on Surgery of the Royal Society of Medicine a case of perineal hernia. When the hernia was reduced a gap admitting two fingers could be felt in the central portion of the levator ani.

CASE 12 Pipelet (3) The patient was a male 60 years of age who seven years ago slipped with legs widely separated the accident was followed by severe pain in the perineum and since that time the patient complained of a heaviness and irritation in the bladder and perineum. His chief complaint was difficulty in micturition in fact he was unable to urinate except when he manually compressed the perineum. Pipelet found a swelling the size of an egg in the right half of the perineum which was easily reduced and could be traced upward through a definite opening. Treatment with a truss relieved the patient of his symptoms.

CASE 13 Schreger (24) describes a vaginoperineal hernia. The left half of the perineum was elevated into a distinct tumor and the corresponding portion of the vagina was also bulging. The contents were small intestine.

Smellie (5) reports the following two cases

CASE 14 was that of a female who had a hernia to the left of the anus which disappeared in the recumbent position but reappeared immediately upon arising. During one of her confinements the hernia became strangulated but on being poulticed the strangulation was relieved with reduction of the hernial contents. At a second confinement the hernia again became strangulated but Smellie ruptured the membranes and thus was enabled to hold the hernia back.

CASE 15 was that of a female who shortly after confinement noticed a small hernia upon the left side which increased in size. In the eighth month of a second pregnancy the hernia became strangulated. Smellie was compelled to incise the hernia and evacuated a large quantity of purulent material subsequently feces also discharged through the wound but ultimately the patient recovered.

CASE 16 Wolff (26) The patient was a female 36 years of age who while loading hay onto a wagon with legs widely separated suddenly felt a pain in the nates and on palpating the region felt there a swelling of the size of a walnut which rapidly increased in size. It was reduced through an opening

located between the tubercles of the vagina and rectum. It increased in size until it finally reached down to the popliteal space and had to be supported by a sort of suspensory bag.

For the reasons that just as the autopsy records of the cases of Bose and of Hartman they are most probably cases of pudendal or better said subpubic hernia I am inclined to exclude from the accepted cases of perineal hernia the following three clinically observed cases which are occasionally reported as true cases of perineal hernia. They are the cases reported by Curade (27) Mery (28) and von Winckel (29).

There is one further case that occasionally masquerades among the perineal herniæ and that is the case of LaCoste (30). I have deemed it best to exclude this case entirely; a careful study of this case makes it very probable to me that the case was not even a hernia but some form of a sacral meningocele.

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HEPATITIS, A CONSTANT ACCOMPANIMENT OF CHOLECYSTITIS¹

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DURING the past year I have been greatly impressed by the frequency with which an enlarged liver is found associated with inflammation of the biliary tract. So often have the two conditions been present simultaneously that it seemed as if the observation of their association by clinicians and pathologists must have been a frequent one. The literature however and particularly the textbooks deal so scantily with the subject that the impression is gained that only in a small proportion of cases of biliary tract disease is there an enlarged liver. In fact it has been impossible to find that any careful study of the liver has ever been made in cases of biliary tract infection except for those associated with abscess formation and the condition of so called biliary cirrhosis. Curiosity as to the origin and nature of the hepatic enlargement when no abscess was present led to the excision of pieces of the liver for microscopical and bacteriological study during the course of the operation on the gall bladder or bile ducts.

The study of the excised tissue in conjunction with the observation of the conditions present in the extrahepatic biliary tract and the clinical aspects of the various cases has resulted in the establishment of certain very interesting and apparently very important facts. These may be epitomized as follows: (1) In cases of acute or subacute cholecystitis there has been constantly found in the liver microscopical evidence of inflammation. (2) The hepatic inflammation is characterized by leucocytic infiltration of the interlobular or periportal sheaths in the more severe types of inflammation the infiltration may involve also the parenchyma at the peripheries of the lobules and be associated with more or less oedema, slight necrosis and moderate fat infiltration. (3) Cultures from both the liver tissue and from the bile in the gall bladder have usually revealed the same organism in each case. (4) In chronic chole-

cystitis sections of liver tissue often show a picture practically identical with that of an early case of cirrhosis. (5) The inflammatory reaction in the liver is apparently chiefly a pericholangitis. (6) The gross enlargement of the liver is probably usually due chiefly to oedema. (7) Generally the liver will subside to normal dimensions after sufficient time has elapsed following appropriate surgical treatment although in some of the more chronic cases only a marked diminution in size has occurred after nearly a year instead of a complete return to normal dimensions.

LITERATURE

A study of the literature on enlargement of the liver in association with disease of the gall bladder reveals the following:

Riedel (1) in 1888 called attention to the frequency with which disease of the gall bladder is accompanied by a tongue shaped extension of the part of the liver lying under the cartilages of the tenth and eleventh right ribs. He regarded this process as a result of biliary disease for he considered that this partial extrusion of the liver from its normal space must be due either (1) to a narrowing of the space or (2) to an enlargement of the liver and that in the absence of conditions which would induce a narrowing of the space it was more reasonable to assume that the liver had become enlarged as a result of biliary tract disease. Since Riedel's article was published this tongue like process of the liver has frequently been called Riedel's lobe.

There is however a conspicuous lack of agreement in the literature concerning the frequency of association of an enlarged liver with biliary tract disease and concerning the nature of the hepatic hypertrophy. Kehr (2) quotes Langenbach as saying that an enlargement of the liver is present only with obstruction of the common duct and on the other hand he quotes Fink as considering prac-

tically every case of biliary tract infection to be associated with liver swelling. Kehr himself however thinks that an enlargement of the liver is present in 15 to 20 per cent of cases of cholecystitis viz in those with cholangitis. Mayo Robson (3) states that in infective cholangitis the liver is not at first enlarged but later may be considerably enlarged that among the complications are diffuse hepatitis cholecystitis etc and that in suppurative cholangitis there is usually progressive enlargement of the whole liver which may descend as low as the umbilicus. Owncke (4) remarks that in cases of cholelithiasis the liver is as a rule distinctly enlarged due perhaps to stasis of bile or in the case of women to the effects of laceration.

Priesman (5) mentions the occurrence of Riedel's lobe in cases of enlarged gall bladder with stone in the cystic duct. He also states:

Cholecystitis sometimes occurs in women of advanced years who never have had any gall bladder trouble before. As I have seen it the attack has always followed a gross indiscretion in diet and during the first day or two has resembled ptomaine poisoning. The symptoms are sudden epigastric pain with nausea and vomiting prostration and moderate fever. On the second or perhaps the third day an enlargement in the liver region with great tenderness on pressure can be made out. *This enlargement is essentially the swollen gall bladder.*

It is evident from all this that there is a very wide divergence of opinion in the clinical literature concerning both the frequency of the enlargement of the liver and the nature of the tender mass which is so commonly felt in the right hypochondrium in cases of cholecystitis. There is no doubt of course that in many cases an enlarged tender gall bladder can be felt but it will be shown in this paper that the tenderne- clotted and the palpable mass are often due to the presence of an enlarged inflamed liver.

TYPES OF ENLARGED LIVERS

In the last 30 cases of biliary tract disease which have come under my observation at operation there has been observed a distinct

enlargement of the liver in 26 or in 87 per cent. In the remaining 4 cases there has been definite gross evidence of previous or existing pathological change in the liver other than an enlargement. The differences presented in the gross appearance of the various livers observed allow a rough classification into three main types: (1) the large soft cedematous liver with rounded edge which occasionally is present at a level as low as the anterior superior iliac spine; (2) the firm liver with a sharp edge and a moderately cirrhotic consistence with slight enlargement or moderate atrophy; (3) the liver of normal size or but slightly enlarged which appears to present features both of a moderate cirrhosis and an acute cedema. Of these three types the first is by far the most common and is most likely to be seen in those patients whose histories and clinical findings indicate a relatively acute and recent process. The second type is encountered most often in the cases which present histories of having had repeated attacks of biliary disease extending over a period of many years and the third type is met with in cases which like Type 2 present histories of many years of gall bladder or bile duct disease but which come to operation soon after an acute attack. The hypertrophy has been most conspicuous in the right lobe but the left lobe also has frequently been found to be enormously enlarged. The color of the liver is usually dark red. When the cirrhotic changes are marked it is usually slightly more brown. In none of the cases of this series was it cream colored or did it indicate extensive fatty change.

MICROSCOPIC FINDINGS

The microscopic findings are characteristic and are almost always of the same type differing in individual cases only in degree. They may perhaps best be summarized in the term pericholangitis. Collections of leucocytes are scattered about in the interlobular tissue. Usually they consist chiefly of small round cells with a few polymorphonuclears and plasma cells. The number of polymorphonuclears is of course largely determined by the acuteness of the process. In cases which at the time of operation have

fever and a leucocytosis relatively more polymorphonuclear leucocytes are to be found. It is not infrequent also in such cases to find that the inflammatory process is not confined to the interlobular sheaths but extends through the parenchymatous tissue of the lobule from the periphery inward. When sections are carefully examined with the high power it is seen that the inflammatory process is chiefly confined to the regions immediately surrounding the finer divisions of the bile ducts and that even when the leucocytic infiltration has invaded the parenchyma it is still apparently the intercellular bile capillaries that are most extensively involved by the surrounding inflammation. The parenchymatous cells themselves show but little change except for an apparently oedematous condition as indicated by their swollen and slightly granular appearance. It is rare to find fat vacuoles to any considerable extent. Necrosis when it is present at all is limited to small areas and is usually at the periphery of the lobule.

In the more chronic cases those which conform to Type 2 rather extensive changes are commonly found; these consist chiefly of an increase in the amount of connective tissue in the interlobular sheaths and particularly around the small bile ducts. Apparently also this increase is accompanied by an actual diminution in the size of the lobule so that the changes of a well marked cirrhosis are evident. The Type 3 cases microscopically show as would be expected evidences of an acute inflammation in addition to well marked cirrhotic changes. Pieces of tissue which have been removed immediately adjacent to the gall bladder show slightly more extensive inflammatory changes than do those which have been taken at a distance of a couple of inches away from the gall bladder site especially if the cholecystitis is very acute and is accompanied by much pericholecystitis. But yet the difference is not so striking as might be supposed.

BACTERIOLOGICAL FINDINGS

Cultures have been made in ten cases both from the piece of liver removed and from the bile. The piece of tissue to be cultured was dropped under aseptic precautions into a

flask of broth and macerated with a sterile glass rod. It was examined after 24 hours incubation and if a growth was present subcultures were made on plain and blood agar and later carried through additional suitable media for identification. Cultures from the bile were made in essentially the same way by inoculating bile directly into flasks of broth. In one case no growth was obtained from either the liver or bile and in one case growth was obtained from only the bile. In the remaining eight cases growth of the same organism or organisms was found in cultures of both the liver and bile. The colon bacillus was obtained in pure culture both from the liver and the bile in five cases. In one case it appeared in association with a streptococcus from both the liver and bile and in one case it was found in pure culture from the bile alone. In two cases a streptococcus was obtained in pure culture from both the liver and the bile. Of the two cases which yielded a streptococcus one was a severe empyema of the gall bladder associated with three large stones and the other was a case of simple cholecystitis without stones in which the gall bladder wall was moderately thickened and adherent to the duodenum. In this latter case symptoms of soreness and tenderness had been present in the region of the gall bladder for about six months. There had never been a severe acute attack of pain. The liver was found to be markedly enlarged and soft and to show microscopically more than the usual number of polymorphonuclear leucocytes for a case which was unaccompanied by fever, leucocytosis or other evidence of acute exacerbation. There was no evidence of ulcer of either the stomach or duodenum. Of the five cases in which the colon bacillus was obtained in pure culture both from the liver and the bile three were associated with stones; one had a deposit of fine sand like material in the gall bladder and the other presented a thickened gall bladder with numerous adhesions and thick, very viscid, light green bile. The case in which the colon bacillus was accompanied by a streptococcus had multiple small stones in the gall bladder. The organisms which were considered to be colon bacilli were gram negative, slightly motile, bacilli

which produced indol formed gas in dextrose media and acidified milk. Those which were identified as streptococci were gram positive cocci arranged in small chains which acidified milk. No attempt was made to distinguish them sharply from pneumococci since the object sought was to determine that the organisms from the liver and bile were identical rather than to identify them positively as a certain type of organism. As a further check on the conclusion reached that a given organism was actually an infective agent agglutination tests were made with the patient's serum on the bacteria isolated from both the liver and the bile in several cases. In one case a colon bacillus obtained from both liver and bile was agglutinated by the patient's serum in a dilution as high as 1 to 80 and in another case in a dilution as high as 1 to 40 whereas normal serum agglutinated both strains in a dilution only as high as 1 to 10. In the one case in which the isolated streptococcus was tested with the patient's serum unsatisfactory results were obtained. It was felt however that the findings with agglutination tests on the colon bacilli were sufficiently conclusive to justify the statement that in each case not only were the two strains of colon bacilli isolated respectively from the bile and the liver identical but that they were also infecting agents.

METHOD OF OBTAINING PIECE OF LIVER FOR EXAMINATION

The method of obtaining a piece of liver for examination was to remove a small wedge from the edge of the liver. This piece has been taken sometimes near the gall bladder and at other times at a distance of a couple of inches away from it. Invariably the piece has been removed from the right lobe. It would probably be interesting to compare a piece removed from the left lobe with one taken from the right lobe in a given case in order to compare the findings in the piece obtained from a region so far away from the gall bladder with one nearer to it. As yet this has not been done. The hemorrhage was always easily controlled by drawing the cut edges together with one or two catgut sutures. After removal the piece was divided one part

being used for culture and the other for microscopic examination. That it is not a dangerous procedure to remove a small piece of liver in this way is shown by the fact that there has not been a fatality in this series.

Several illustrative cases may be summarized as follows to show the characteristic features under discussion.

CASE 1. Mrs. B. age 52 housewife. Complaints pain under right costal arch, pain in right lower quadrant of abdomen, bloating, constipation, vomiting, backache and pain in right shoulder. During past 20 years she had had about ten attacks of pain in the right lower quadrant, sometimes accompanied by vomiting and fever. Pain had been present under the right costal arch for about two years but not constantly present. It had been absent for as long as three months at a time. She had had severe attacks of pain in this region. Each on these occasions had required hypodermics for relief. The last one was two weeks before. The pain was referred to the right shoulder and spine. There had never been jaundice. At times of severe pain she was nauseated and vomiting occurred. She thought she had had no fever with these attacks. She was the mother of one child. Previous illnesses were diphtheria at 1 year, spinal meningitis at 18, erysipelas at 30, repeated attacks of tonsillitis for which the tonsils were removed at 31. Otherwise the history was of no special importance.

Examination revealed a very well nourished woman. The head, neck and chest showed nothing of significance. In the abdomen there was rather marked tenderness under the right costal arch. On deep inspiration palpation revealed what seemed to be either the edge of the liver or an enlarged gall bladder descending to a distance of about three fingers breadth below the costal margin. There was moderate tenderness in the appendix region. Otherwise the physical examination was negative except for an old perineal laceration, with a cystocele and rectocele and a small urethral caruncle. The urine was normal except for a moderate number of leucocytes. The blood count showed 95 per cent hemoglobin, 4,630,000 red cells and 7,100 leucocytes. An examination of the stomach contents showed on two occasions after test breakfasts a reduced acidity. Free hydrochloric acid of 7 and at another time no free hydrochloric acid with total acidities of 27 and 20 respectively but with a moderate amount of intimately mixed mucus. There was no blood in either the stomach contents or the stool. A diagnosis was made of chronic cholecystitis and appendicitis.

At operation under ether anesthesia a right rectus incision was made which as extended inwards at the upper margin parallel and close to the costal margin. The gall bladder was found to have a greatly thickened wall and to be gray instead of dark blue in color. It was adherent to the pylorus.

the colon and the duodenum. It extended nearly a hand's breadth below the costal arch but was not distended. The liver was large and extended about three fingers' breadth below the costal margin. It was of normal color but very soft and oedematous. The edge was round rather than sharp. After separating the gall bladder from its adhesions an enlarged gland was found at about the beginning of the cystic duct. The gall bladder was removed from below upward by first identifying the junction of the cystic and hepatic ducts by dissection of the hepatoduodenal ligament, doubly clamping and dividing the cystic duct and then stripping up the cystic duct and gall bladder from their peritoneal attachments. The stump of the cystic duct was swabbed out with strong carbolic acid, transfixed and ligated with catgut after being careful to see that the cystic artery was included in the ligature. The peritoneum was then closed over the old bed of the gall bladder with catgut. The appendix was removed in the usual way and the stump inverted with a purse string suture of catgut. A careful examination of the stomach, the duodenum and the pancreas revealed nothing abnormal. A small piece of the right lobe of the liver about two inches to the right of the gall bladder was removed for bacteriological and histological examination. The gall bladder was opened and found to contain thick bile with a sediment of very fine sand like substance deposited on the surface of the mucosa. The mucosa was markedly congested and presented the appearance of the so called strawberry gall bladder. The appendix was about three inches long. It was free from adhesions but evidence of a chronic recurrent appendicitis was presented in a fibrous tip with obliteration of the lumen for about a half inch, thickened walls and the presence of a few punctate hemorrhages in the mucosa. The urethral caruncle was cauterized. The total duration of the operation was one hour and fifteen minutes. The postoperative course was uneventful. The patient was up walking around on the thirteenth day and left the hospital on the nineteenth day.

Cultures from both the liver and the bile in the gall bladder revealed a colon bacillus in pure culture. Both of these organisms were agglutinated by the patient's serum in dilutions of 1 to 40 whereas normal serum agglutinated them only in dilutions of 1 to 10. It was intended also to make cultures from the wall of the appendix but through a mistake this was not done.

Histologically the liver presented a striking picture. Many areas of leucocytic infiltration could be plainly seen with the low power. The larger areas of infiltration were confined to the interlobular tissue but occasionally a small collection of leucocytes could be seen within the liver lobule. Under higher power it was evident that the infiltration was more marked around the small bile ducts rather than around the blood vessel. The cells present included large numbers of polymorphonuclear leucocytes, a few plasma cells and the remainder

small round cell. The parenchymatous cells were enlarged granular and spheroid instead of cuboid indicating an oedema of the parenchyma. Fat vacuoles were rarely visible. There was no necrosis and no increase of connective tissue. Figure 1 is from a low power photograph which shows the leucocytic infiltration in the interlobular or periportal structure. Figure 2 was made from a higher powered microphotograph. The infiltration of polymorphonuclear leucocytes around a small bile duct is clearly shown at *a* at *b* a similar but smaller infiltration is seen around what is apparently a bile capillary (or space). The parenchymatous cells are seen to be large and spheroidal instead of cuboidal.

Summary. History of pain in gall bladder region for two years. No jaundice. No fever with any of the attacks. Operation disclosed an enlarged oedematous liver with a gall bladder whose thickened wall were adherent to other viscera. A sand like deposit on the mucosa of the gall bladder. Despite the absence of fever, leucocytosis or other evidence of acute inflammation the liver showed an extensive inflammatory process in which even polymorphonuclear leucocytes were playing a prominent part.

CASE 2. Mrs W, age 72. Indefinite symptoms of upper abdominal and epigastric distress for about 10 years. For last six months she had had more discomfort than usual which had been characterized by soreness and more definite localization of pain in region of right upper quadrant. She had been practically bedridden for the past two months and had lost approximately 10 pounds in weight. She had had occasional attacks of vomiting and recently on two or three occasions it had been necessary for her physician to administer a hypodermic because of severe colic like pain in the region of the gall bladder which was also referred to the right shoulder. There had never been jaundice. There was no history of typhoid. She was the mother of three children who were all living and well at the time of her entrance into the hospital.

On examination the patient was found to be a very feeble old lady with marked signs of senility and in a very poor state of nutrition. A large mass in the upper right quadrant of the abdomen was evident on inspection and on palpation this mass was found to be firm slightly tender and to descend on deep inspiration to as low as the umbilicus. Cardiac dullness extended 2 centimeters to the left of the mamillary line, there was marked arrhythmia and the systolic blood pressure was 170 millimeters. The temperature was 98.4, the pulse 90, the leucocytes 5,900, the urine normal. X ray examination showed a large pear shaped mass extending downward from the liver shadow to nearly the umbilicus. This mass corresponded to the mass discovered on physical examination. It seemed probable that the mass was an enlarged gall bladder with obstruction at the cystic duct. Operation was advised but a very doubtful prognosis was given because of the patient's extremely feeble condition with her asso-



Fig. 1 (left) Case 1 Interlobular leucocytic infiltration of liver

Fig. 2 Case 1 a Shows polymorphonuclear leucocytes collected around a small bile vessel in the liver. At b are a few polymorphonuclear cells around a bile capillary. Parenchymatous degeneration of the liver cell and a few fat vacuoles are evident

tear at the time of the birth of her child. Although this tear was repaired at the time by her physician, the stitches failed to hold and she now had complete incontinence. The child died a few hours after birth and since then the patient had been in bed continuously.

Examination showed moderate tenderness over the entire right side of the abdomen and the right loin. The abdominal muscle on the right side were rigid and palpation was difficult. Nothing definite could be felt in the nature of an enlarged kidney, a mass of any kind, etc., but marked tenderness was elicited under the right costal arch on deep inspiration. The urine contained a small amount of pus from which a colon bacillus was isolated in pure culture. A cystoscopic examination including catheterization of the right ureter with a thorium injection (by Dr. N. G. Allcock) showed a kink in the ureter about three inches below the renal pelvis. The functional test was normal. X-ray examination also was normal except for the kink in the right ureter revealed by the thorium injection. The leucocytes were 10,500 and the temperature 99.6. The next day after the cystoscopic examination she had a sudden severe attack of pain in the right upper quadrant associated with a slight chill, nausea without vomiting and marked tenderness in the region of the gall bladder. The temperature ascended to 101 and the leucocytes to 12,000. A diagnosis was made of an acute exacerbation of a chronic cholecystitis and of a slight kink in the right ureter without hydronephrosis but with slight pyelitis.

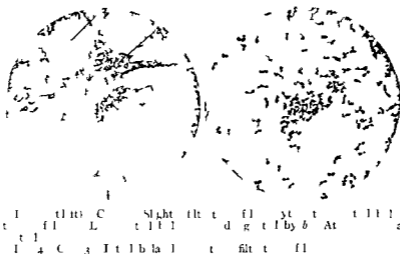
Operation was performed on the gall bladder two days later after the maximum temperature had decreased to 99. The liver was found to be large and very soft. The edge was rounded rather than sharp and came down to a level of two inches below the costal arch. The gall bladder was slightly larger than normal but was not distended. Its walls were thick and of a pale gray color rather than of the normal bluish tint. There were no adhe-

sions to the gall bladder but many small stones could be felt through the wall. The gall bladder was removed in the usual way and found to contain about one hundred small stones with thick tarry bile. Cultures of the bile showed a pure culture of the colon bacillus. A piece of the liver was removed practically at the site of the gall bladder. The rectovaginal fistula was repaired after the removal of the gall bladder. The total duration of the operation was one hour and twenty minutes. The post-operative course was normal. At the time of her discharge from the hospital three and one half weeks after the operation she was feeling perfectly well, had gained approximately 10 pounds in weight and could control her bowel movements perfectly. The urine no longer contained pus and she was free from all pain and soreness in both the right loin and the abdomen.

Examination of the piece of liver removed revealed the same type of changes which have been described in connection with the other cases. When seen with the low power of the microscope numerous collections of polymorphonuclear leucocytes and round cells were evident. These were distributed chiefly around the branches of the bile ducts. Cultures from the bile revealed a colon bacillus in pure growth. Cultures were not made from the liver and no agglutination tests were made with the patient's serum on the organism recovered from the bile.

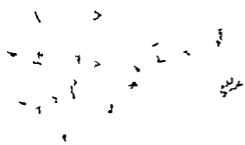
Summary—Young woman presenting history of distinct attack of gall bladder trouble while eight months pregnant. Several subsequent attacks. Examination made about one month after birth of her child showed distinct evidence of gall bladder disease and slight kink in right ureter. At operation a markedly enlarged liver was found with many small stones in the gall bladder.

CASE 5—Nick I., aged about 45, Greek laborer. Brought into hospital moribund with no history obtainable. Death about two hours later. At autopsy performed about an hour after death a greatly enlarged liver was found of which the lower



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I t t t C C l l l l b t d f m
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n o r m l o t h t t h t h l p o b j c t e l r e
r l a y s t o t h r e l o b u l e s t h c f e l l A s a
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m e c n p c u u o u n d t h b l e c l n c l t h a n
o u n d t h b r a n c h o f t h p r t a l A t t h e
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S v G l l b l a d d h i s t o r y e t e n d n g o r a
p e r o d o f h i t e v a r t h a n e n t i r e a b s e o f

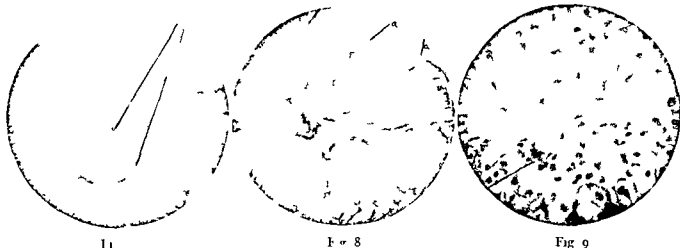


Fig 7 Case 4 Areas of leucocytic infiltration as seen at *a*

Fig 8 Case 4 Higher power of Fig 7 showing extensive inflammatory change at the edge of the liver

a and multiple areas of leucocytic infiltration which are designated at *b*

Fig 9 Case 4 Still higher power showing areas of leucocytic infiltration at *a*

jaundice or any other symptom indicative of obstruction of the bile tract. At operation there were found a slightly atrophic liver which was firm with a sharp edge and cut with increased resistance a thickened gall bladder containing calculi and numerous adhesions between the gall bladder and adjacent structures. Microscopically the finer bile ducts were found to be surrounded by a marked hyperplasia of connective tissue and the lobules were atrophic. The liver in this case corresponded with that described above under Type

CASE 7 Mrs G aged 51. History of indigestion for about three years with several attacks of severe pain in right hypochondrium accompanied by nausea and vomiting. The last attack of moderately severe pain occurred three weeks ago and was diagnosed by her physician as probable gall stone colic. During this attack her maximum temperature was 100. On entrance into the hospital the temperature was normal the leucocytes 8600. The edge of the liver which was tender could be distinctly felt on deep inspiration about two fingers breadth below the costal arch. X-ray examination not only showed the enlarged liver but also clearly revealed a mass of small stone in the gall bladder.

At operation the liver was found to be enlarged so that the lower edge descended to a distance of about two fingers breadth below the margin of the rib. The liver was soft and the edge was rounded. The gall bladder was thickened and was adherent to the pylorus. It was felt to contain several stones. Cholecystectomy was performed in the usual way and a piece of liver was removed. The appendix also was removed although it was practically normal in appearance. After removal the gall bladder was opened and found to contain thick greenish bile and twenty three stones of irregular shapes. Cultures from the bile showed a pure growth of colon bacilli but no growth was obtained from the liver. The total duration of the operation was 45

minutes. The postoperative course was uneventful and the patient left the hospital on the fourteenth day.

Microscopically the liver showed numerous areas of leucocytic infiltration. These were composed chiefly of round cells with occasional plasma cells and were located as usual about the finer bile ducts. Sections of the gall bladder showed a moderate leucocytic infiltration immediately beneath the epithelium. This infiltration consisted in large part of polymorphonuclear leucocytes.

Summary. History of gall bladder trouble for about three years. At operation a thickened gall bladder and stones were found with enlarged oedematous liver. Microscopically the liver showed the usual findings of areas of leucocytic infiltration. A colon bacillus was isolated from the bile but cultures from the liver were sterile.

CASE 8 Miss S aged 31. During last six months patient had had several attacks of pain in right hypochondrium the last two of which were very severe and associated with nausea and vomiting. There had been no radiation of the pain no icterus and no chills. The maximum temperature observed by her physician was 100.4. On admission to the hospital the temperature was 99.6 the leucocytes 9600 and the urine normal. A mass could be felt extending downward from the right costal arch to the level of the umbilicus. This mass was movable on deep inspiration was very tender and seemed to be an enlarged gall bladder. On percussion liver dullness was found as high as the fourth interspace in the mamillary line.

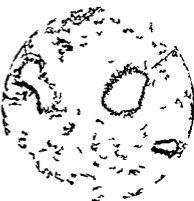
At operation a greatly enlarged and distended gall bladder was found. The liver was deep bluish red in color and very soft. The lower edge was rounded and was at a level almost as low as the umbilicus. The gall bladder was removed in the usual way and a piece of the right lobe of the liver about two inches to the right of the gall bladder



f



F g



I g

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r u m i d i l u t o n s o f t 40

S i t u a t i o n S e v e r a l a t t a c k s o f p a n i n r i g h t
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l e r g a g u s g a l l b l a d l c n t a n i n g t w o c a l
u l u s i t h o i l y l i g h t e l a t i n o f t e m p e r a t u r e a n d
n o r m a l l e c o c y t e C l o n b a c i l l u s o l t e d f r o m
l o t h l e r a n d c o n t e n t o f g l l b l a d d e M i c r o
s c o p i c a l l y t h e l i v e r h o v l i n t e r l o b u l a r h e p a t i t i s

GENERAL DISCUSSION

These eight illustrative cases are sufficient to show clearly that a definite hepatitis occurs with a fair degree of regularity in cases of cholecystitis with acute symptom. In the chronic case there are also almost always positive anatomical change in the liver indicative of a chronic inflammation. The evidence for the assumption of a concomitant hepatitis with cholecystitis of course is most apparent in acute cases in which the liver shows gross changes consisting of enlargement with oedema and tenderness on palpation. Microscopically as has been shown above repeatedly the livers of these cases contain areas of leucocytic infiltration and finally in a number of the cases organisms have been isolated from the livers which by agglutination tests with the patient's sera have apparently been shown to be infecting agents. The regularity with which these



FIG. 13

Fig. 13. Ca c. Rather extensive interlobular leucocytic infiltration.



FIG. 14

Fig. 14. Ca c. Higher power of Figure 13, showing numerous mononuclear cells, a few polymorphonuclear cells.



FIG. 15

Fig. 15. Ca c. Section of gall bladder. Moderate subepithelial and submucosal leucocytic infiltration consisting in a large part of polymorphonuclear leucocytes.

changes have been found even when the constitutional evidences of infection have been slight as shown by normal or but slightly increased temperature moderate or no increase in the number of leucocytes etc indicates that in all probability every case of cholecystitis at least in the acute stage is accompanied by a hepatitis. As a general rule of course the more acute the cholecystitis the more evident will be the associated hepatitis. It is interesting also that the hepatitis occurs regardless of the presence or absence of calculi and regardless of whether or not the cystic duct is obstructed. It is also noteworthy that the clinical association of icterus is an unnecessary factor as shown by the fact that in not one of these 8 cases was jaundice observed.

The pathogenesis of cholecystitis and the question of simple acute hepatitis. The questions naturally arise (1) is the hepatitis primary or secondary to the cholecystitis? or (2) are the two conditions concomitant in origin? A positive answer cannot be given at this time. It is easily conceivable that the gall bladder might be infected secondarily by the descent of bacteria through the bile passages in a case of primary hepatitis or it is equally conceivable that the hepatitis might result from an ascending infection from a primary cholecystitis in a manner analogous to an ascending infection of the fallopian tube in the female or similarly to what ordinarily

supposed to be the course of events in the so called ascending infection of the kidney. Except for those conditions of the liver which are distinctly suppurative in character and the various types of cirrhosis apparently but little attention has been given to a consideration of hepatitis. One is forced to assume from a perusal of the clinical literature that simple transient hepatitis is comparatively rare if the condition of cloudy swelling is excluded. As a matter of fact however the author is convinced that a simple hepatitis is of relatively frequent occurrence. It manifests itself by malaise slight fever (100 to 101.5°) leucocytosis of from 10,000 to 15,000 and the presence of a palpable slightly tender liver edge. The symptoms may be present for only two or three days followed by a disappearance of the tenderness and an inability further to palpate the liver edge. Jaundice may be present. There may be none of the principal characteristics of gall bladder inflammation present such as the typical pain etc. Some of these cases may be hematogenous in origin as indicated by the fact that occasionally one finds the described syndrome occurring during the course of or following an acute tonsillitis others may be due to the conveyance of virulent intestinal bacteria to the liver by way of the portal vein. If it is true as suggested that simple nonsuppurative hepatitis is of comparatively frequent occurrence then it is easy to conceive that



F g f c M d t l c t f l t t f
 t l b l t A t d g t d t l l b l
 A t b f d m l b l t f b t t h
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 m m g f t F e u h l b y t h m s
 c t h t h k f t h l l f t h m l b l d t s
 l f g i b l t t l t h t h m k d t i h y f t l

many case of cholecystitis may be descend-
 ing infections from the liver. Unfortunately
 the experimental work which has been done
 on this question is inconclusive. Doerr (6)
 from his own work, concluded that typhoid
 bacilli enter the gall bladder from the liver.
 His work, however, consisted of only four
 experiments using rabbits. In two of the
 experiments he fed large quantities of typhoid
 bacilli and could find none in the bile in from
 one to three days. In another experiment
 a ligation of the cystic duct was performed,
 the duct cut, and five days later the rabbit
 was injected intravenously with typhoid
 bacilli. When killed twenty-four hours later
 the rabbit had no typhoid bacilli in the gall
 bladder. In another experiment the common
 duct was tied and the animal injected intra-
 venously. The gall bladder eight hours later
 contained typhoid bacilli. In 1909 J. Koch
 (7) described a thoroughly studied case of a
 man who died during an attack of typhoid
 fever. The autopsy showed a moderate chole-
 cystitis with involvement of the mucosa and
 submucosa of the gall bladder. At the apices
 of the papillary folds of the mucosa just
 beneath the epithelium were often found
 clump or nests of gram-negative bacilli,
 apparently *Bacillus typhosus*. The organisms
 were not found in sections in the lumen of the
 gall bladder. From the findings in this case
 Koch concluded that typhoid cholecystitis is

embolic and is not caused by the action of
 infected bile. He concluded also that typhoid
 carriers exist because of the harboring of
 bacilli in the walls of the gall bladder with
 occasional liberation of some into the lumen
 of the gall bladder and thence into the in-
 testine. He also recognized the presence of
 infection of the walls of the large bile ducts.
 Chiarolanza (8) under Koch's direction
 undertook experimental work and arrived at
 conclusions which supported in part the con-
 tentions of Koch and were at variance with
 the experimental findings of Doerr previously
 mentioned. After injections of typhoid bacilli
 both intravenously and subcutaneously in
 rabbits he found a lodging of the bacteria in
 the submucosa of the papillary folds of the
 gall bladder in clumps as if embolism of the
 capillaries had occurred. In all of three
 animals in which the cystic duct was first
 ligated he found bacilli in the bile of the gall
 bladder. In six animals with both the cystic
 and common ducts ligated he found bacilli in
 large numbers in the gall bladder bile. He
 concluded that cholecystitis is due to capillary
 embolism and not to infection from secreted
 infected bile. It is interesting also that the
 livers frequently showed a more or less
 extensive interlobular leucocytic infiltration
 and often a marked increase of interlobular
 connective tissue. The idea of the embolic
 origin of typhoid cholecystitis is also in accord
 with the work of Rosenow (9) on streptococ-
 cus cholecystitis. H. Chiari (10) considers
 that in typhoid the gall bladder is infected
 from bile which in turn is infected by a
 hamatogenous invasion of the liver by
 bacteria. On the other hand Girode (11)
 thought he succeeded in demonstrating that
 typhoid bacilli may gain entrance to the bile
 tracts by descending from the liver and
 Letienne (12) in one case concluded that he
 had demonstrated the same for the tubercle
 bacillus. Lawlowsky (13) found that various
 bacteria could enter the gall bladder from the
 liver after subcutaneous injection. Guetterer
 (14) was able to show experimentally that
Bacillus prodigiosus passes through the liver
 in one minute from the portal vein to the
 general circulation. Biedl and Kraus (15)
 claim to have found that bacteria can pass



Fig. 17



Fig. 18



Fig. 19

Fig. 17. Case 8. Leucocytic infiltration is seen to consist of large number of polymorphonuclear leukocytes and in part of mononuclear cells.

Fig. 18. Case 8. Section through gangrenous portion of gall bladder. The epithelium is absent and the musculature is disorganized.

Fig. 19. Case 8. Section taken at upper part of gall bladder. The epithelium and musculature are in fairly good condition. At *a* is seen an area of leucocytic infiltration. Clumps of colon bacilli were seen in the subepithelial and submucosal tissues in specially stained sections.

through the liver into the bile as if in a process of normal secretion. At their hands intravenous injection of staphylococci was followed in from 13 to 35 minutes by their appearance in the bile.

From this more or less confusing literature it would appear that bacteria may gain entrance into the gall bladder both by an embolic process involving the capillaries of the gall bladder walls and by direct descent from the liver. One must not lose sight of the possibility also that bacteria may perhaps occasionally gain entrance into the gall bladder by an ascending infection from the intestine up the common and cystic ducts. Which of these various possibilities is the most important in the production of cholecystitis remains to be determined. In a later paper it is hoped to describe additional experimental results bearing on this point. It seems fair however now to draw the inference that some cases of cholecystitis may be due to a descent of bacteria from the liver. Nicholls (16) writes of finding bacteria constantly in livers at autopsy and Ford (17) has described the nearly constant presence of them in the livers of freshly killed normal animals. Colon bacilli and staphylococci were found most frequently. With apparently such a steady stream of bacteria passing through the liver and into the gall bladder it

seems reasonable to suppose that occasionally at least a virulent strain might easily induce a hepatitis in transit and a later inflammation of the biliary passages. Any focus which would discharge virulent bacteria into the portal system would therefore become a potential source of infection for the liver and gall bladder. The well recognized intimate association of appendicitis and cholecystitis may perhaps be explainable on this basis. In this connection it is interesting to note that Gale (18) considered that a case of cholecystitis under his observation had its origin in hemorrhoids and that the infection was transported through the hemorrhoidal veins to the portal vein and thence to the liver and gall bladder. On the other hand if a cholecystitis is well established it is very probable that an ascending infection of the liver may be constantly recurring possibly through the lymphatics surrounding the bile passages. In some of our cases particularly Case 1 the type of lesion in the liver strongly suggests a pericholangitis of this type.

Relationship to pathogenesis of cirrhosis of liver. The finding of cirrhotic changes as shown especially in those cases which come under the classification of Type 2 is of great interest particularly from the standpoint of the etiology of cirrhosis in general. The occurrence of cirrhotic changes in the liver



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 l. l. d. h. h. l. t. t. d. th. j. k. t. th. k. ll. bl. d. l.
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secondary to disease of the bile tracts is so well known that the distinctive name of biliary cirrhosis has long been used to distinguish this condition. But at least is ordinarily employed the term is applied to that form of cirrhosis which follows obstruction of the hepatic or common ducts. In 1888 Mangelstadt (19) collected all the reported cases of cirrhosis of the liver. Of the total of 11 cases 184 were associated with obstruction of the biliary passage and gave a history neither of syphilis nor of certain or doubtful alcoholic intemperance. The assumed importance of the factor of biliary obstruction in this connection has become so deeply rooted that it has commonly been supposed that the so-called biliary cirrhosis is due to the stasis of bile *per se*. Case 6 clearly indicates that it is possible to have well marked cirrhotic changes even when there is not the slightest evidence that there has ever been any stasis of bile. (Oumcke (20)

mentions an extension of a cholangitis up into the finer branches of the hepatic duct with proliferation of the interstitial tissue in the liver with new formation of bile passages—in other words biliary cirrhosis. Yet later he speaks of biliary cirrhosis as if it were inseparably connected with bile stasis.

Theoretically it would seem that the mere damming of bile back into the liver could scarcely induce serious changes unless occurring to such an extent that there was impairment of the circulation because bile is normally present in the liver cell. It would seem rather that the infection which is associated with such a condition must be the more important factor for the changes are essentially of the nature of a chronic inflammation. Especially would this be the case when the infection is chiefly around the biliary passages and hence involves the interlobular tissues as has been found to be the prevailing characteristic of the inflammation observed in the cases described in this article. Mention should be made in this connection however that Harley (21) observed a moderate cirrhosis without jaundice in cats one year after ligating the left hepatic duct. It is unfortunate that he made no bacteriological studies and therefore that the importance of infection cannot be determined in his results.

A detailed discussion of the possible bearing of these changes upon the pathogenesis of ordinary atrophic cirrhosis of the liver must be reserved for a later paper. A few of the points involved however may well be considered. It has been customary to consider that the chief histological characteristic of the atrophic type of cirrhosis is a perivascular inflammation and thickening involving the tissue surrounding the branches of the portal vein as distinguished from the inflammation surrounding the fine branches of the bile ducts in the biliary cirrhosis. Adams (22) for example classifies cirrhosis into portal true biliary (Hanot) obstructive biliary etc. Other consider that no sharp anatomical distinction can be made between the so-called portal and biliary type of cirrhosis. Oumcke (23) in discussing biliary cirrhosis states

The proliferation of connective tissue and

the atrophy of the liver cells may attain as marked a degree as that seen in atrophic cirrhosis so that it may lead to congestion of the portal system. No characteristic anatomic difference can be found between cirrhosis due to biliary stasis and other forms of cirrhosis. The proliferation of the bile ducts which Charcot's pupils consider so characteristic is by no means specific on the contrary the same picture is seen not only in every form of interstitial hepatic inflammation but in acute atrophy as well. Concerning the commonly supposed etiological relationship of alcohol to atrophic cirrhosis Adami (24) states "while alcohol has been credited with being the etiological factor (in portal cirrhosis with contraction) in about 60 per cent of cases experimental investigations do not bear this out. There is already an extensive literature which indicates that bacteria play an important role in the production of cirrhosis. Adami himself has obtained strong evidence favoring this view. Weaver (25) in 1899 produced cirrhosis of the liver in guinea pigs by subcutaneous and intra-peritoneal inoculation of a colon bacillus. Hektoen (26) in 1901 also produced it in guinea pigs rabbits and dogs by subcutaneous injections of a pseudo diphtheria bacillus. Adami (7) discussing the confusion concerning the relationships of bacteria alcohol etc. to hepatic cirrhosis concludes that "before bacteria can act there must be a lowering of vitality of the liver parenchyma. This can be produced by alcohol bacterial toxins and certain organic fatty acids."

Type of operation. It may not be out of place to discuss here briefly the bearing of our findings upon the question of what kind of an operation seems most suitable for infections of the gall bladder i.e. whether in general the gall bladder should be removed or simply drained. It is evident from the cases described above that any operative measure directed solely at the gall bladder will be able theoretically at least to deal with only part of the infected tissue for as has been shown the infection is present in the liver as well as in the gall bladder. In other words we should recall that there is both an intra-hepatic and an extra-hepatic biliary tract and

that both are involved in the inflammation. At best our present surgical methods will allow us to deal only with the extra-hepatic tract which in total length must be much smaller than the intra-hepatic system of bile channels.

Even here of course the amount of tissue which can be extirpated is limited to the gall bladder and cystic duct. At first thought therefore it would seem that the removal of such a relatively small part of the whole tissue involved would have a negligible effect in curing the patient. But nevertheless the evidence is strong that gall bladders which have once become seriously infected tend to harbor bacteria actually in their walls and these in turn apparently may give rise to frequent ascending infections of the liver apparently through the lymph channels around the bile tracts. These considerations would suggest that perhaps the best operative procedure would be one which combined the extirpation of the maximum amount of infected tissue which can be safely done with the establishment of the most generous possible drainage of the rest of the infected tissue. The operation devised by Kehr (28) seems to fulfill these requirements. It consists of the removal of both the cystic duct and gall bladder with the institution at the same time of drainage of the hepatic duct accomplished by the insertion of a small tube through the opening where the cystic duct previously joined the hepatic duct upward into the hepatic duct toward the liver. But unfortunately this operation seems to be associated with an increased risk both as to the immediate mortality and as regards the subsequent possibility of scar formation causing a stenosis of the hepatic duct. On the other hand it is open to question if artificial drainage of the hepatic duct in cases in which there neither has been nor exists at the time an obstruction of the common duct is of any more value than the drainage obtained in the natural way. If there is no distinct advantage in the hepatic duct drainage then the removal of the infected tissue contained in the cystic duct and gall bladder should come near to fulfilling the theoretical requirements. Moreover clinical results certainly seem to indicate that after removal of the infected tissue

contained in the gall bladder and cystic duct the hepatic inflammation can handle itself.

The fact that in many cases a simple drainage of the gall bladder has resulted in a permanent relief from symptoms probably indicates only that in a certain percentage of cases the infection of the biliary tract has been sufficiently superficial to permit a fortunate restoration to normal conditions. One of the great difficulties in deciding upon the nature of the operation to undertake in a given case is the determination at operation of whether or not the gall bladder is extensively enough involved to preclude the probability of a restoration to a normal condition if allowed to remain. The various point which might profitably be considered in arriving at such a conclusion will not be discussed in this paper except to state that probably the existence of a pericholecystitis as evidenced by adhesions of the gall bladder to other viscera almost always indicate that an extensive invasion of the gall bladder wall has occurred and that probably therefore there will be recurrences of trouble if the gall bladder is allowed to remain. In several of the series of cases of which this paper is a report cholecystostomy rather than cholecystectomy was performed in a few because the poor general condition of the patients warranted only the safe, if possible procedure even at the risk of an incomplete cure in others because of a desire to determine if after cholecystostomy the enlarged liver would diminish in size. In every case a marked diminution in the size of the liver occurred. It should be stated however that in general those cases which presented the most marked pathological changes in the biliary tract were treated by cholecystectomy rather than by simple drainage. The finding in Case 2 that the infecting organism could be recovered from the bile drainage as late as 10 days after the operation is interesting as indicating the length of time required for the complete elimination of the infection from the liver and bile tracts. Terrier (9) reported finding the colon bacillus in the bile from a fistula four months after operation. No proof however was given that the organism was actually an infecting agent. It may have been merely a non pathogenic strain which

had been carried to the liver from the intestine and eliminated in the bile.

Diagnostic value of an enlarged liver. From a diagnostic point of view the existence of a hepatitis with its attendant enlargement of the liver is apparently of great importance. In several of our cases in which the presence of gall bladder disease has been doubtful the occurrence of an enlarged liver has been made the determining factor in the diagnosis and the subsequent findings at operation have justified the wisdom of placing great importance upon it in diagnosis. It need hardly be mentioned that the hepatic enlargement is important chiefly in those cases in which there is no demonstrable reason for the hypertrophy except the biliary tract infection. In one case in which the diagnosis was very doubtful between gall bladder disease and a low freely movable kidney with slight intermittent hydronephrosis the fact that the liver was enlarged both upward and downward was the determining factor in concluding that the trouble was related to the gall bladder rather than to the kidney although the low kidney had been clearly demonstrated by X ray. At operation the gall bladder was found to contain two large stones with evidence of marked old pericholecystitis. Cholecystectomy gave complete relief of symptoms. The X ray can frequently demonstrate the hepatic enlargement when ordinary physical signs leave one in doubt whether there is any hypertrophy present.

SUMMARY

In 30 cases of biliary tract disease which have come to operation a distinct enlargement of the liver has been present in 26 or in 87 per cent. In the remaining 4 cases there has been definite gross evidence of previous or existing pathological change in the liver other than an enlargement.

During the course of the operation small pieces of liver tissue have been removed for bacteriological and microscopical study. The results of these examinations may be epitomized as follows:

1. In cases of acute or subacute cholecystitis there has been constantly found in the liver microscopical evidence of inflammation.

2 The hepatic inflammation is characterized by leucocytic infiltration of the interlobular or perportal sheaths in the more severe types of inflammation the infiltration may involve also the parenchyma at the peripheries of the lobules and be associated with more or less œdema slight necrosis and moderate fat infiltration

3 Cultures from both the liver tissue and from the bile in the gall bladder have usually revealed the same organism from each of the two different sources

4 In chronic cholecystitis the liver microscopically often presents a picture practically identical with that of an early case of cirrhosis

5 The inflammatory reaction appears to be chiefly a pericholangitis

6 The gross enlargement of the liver is probably usually due chiefly to œdema The enlarged livers in this series have always diminished markedly or returned to normal size after appropriate surgical treatment

Marked cirrhotic changes have been shown to occur in the liver even when there has never been a stasis of bile

The importance of these findings in relation to the pathogenesis of cirrhosis of the liver in general is discussed

From the standpoint of the diagnosis of obscure or doubtful cases of biliary tract disease the presence of an enlarged liver is of the greatest importance

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FIG. 2 Specimen removed from author's patient. See pathological report.

A section shows the cortex increased in thickness and containing a few cavities averaging 1.5 centimeters in diameter. The walls of the cavities are reddish and tissue comprising walls can be shelled out of kidney substance easily. Also scattered throughout cortex are small yellowish dots slightly larger than pinhead. The pyramids are atrophied. The pelvic calyces are markedly dilated and the pelvis itself is dark red in color, showing punctate hæmorrhages. In a few words the kidney showed (1) infarcts evidently recent (2) chronic diffuse nephritis (3) acute pyelitis (4) pyonephrosis (5) hydronephrosis.

This case presents several points of interest. In the first place the history clearly brings back the onset of patient's trouble to the time when he was 10 years old. Nephrolithiasis in children is indeed rare if one excludes the so-called uric acid infarcts of newborn infants with the resultant passage of gravel. There can be no question as to the presence of stones in his early youth as the patient volunteered the information that the character of the pain at onset of his trouble was identical in character with the pain he suffered just previous to his operation, the only difference being the greatly increased severity of his later pains.

The much mooted discussion pyelotomy versus nephrotomy as to the method of choice in the removal of kidney stones presented itself during the first operation. A large stone was very definitely palpable through the pelvis and none was felt through the kidney substance. Nevertheless the roentgenograms clearly showed the presence

of stones embedded in the kidney proper and the great value of a good roentgenogram properly interpreted was manifest when the kidney having been incised two beds of smaller stones, one in each pole, in addition to the pelvic stone were revealed.

The stones were embedded in the renal parenchyma proper and not in dilated calyces. The usual conception of the formation of stones in the pelvis or calyces is not supported by the findings in this case. The presence of stones in the parenchyma proper speaks for their formation here. The pelvic stone in this case may have been extruded from the parenchyma into the lumen.

To what may we attribute the hæmorrhage that followed the primary operation? The highly specialized and therefore extremely delicate renal parenchyma after the manipulation and cutting incident to the operation reacts to trauma as do all other tissues only to a greater extent. That is to say swelling takes place. This subsequent oedema is often taken care of by tubal drainage of the kidney substance proper. But it seems to me not good surgery to destroy further the renal parenchyma by the insertion of a tube. The desired result can be secured and the disadvantages of the above drainage obviated according to my way of thinking by the performance of a pyelotomy, insertion of a tube into the pelvis of kidney and complete closure of the nephrotomy wound. The opening in the pelvis will prevent any further

increased intrarenal pressure consequent upon the blocking of the pelvo ureteral junction by a blood clot.

By adopting this procedure the subsequent edema of the kidney is provided for. Regulation of the intrarenal pressure in this manner will in all probability do a vast secondary hemorrhage.

In three similar cases since I was fully rewarded with uneventful recoveries after nephrotomies by instituting pelvic drainage as previously outlined.

This subject it seems to me is extremely timely as the great world war is no doubt

presenting volumes of cases of kidney traumatism and hemorrhages. The application of the principle of pelvic drainage for kidney hemorrhage either surgical or traumatic such as hemorrhages being associated with and consequent upon increased intrarenal tension secondary to ureteral blockage with a blood clot will I am sure result in the conservation of many kidneys heretofore doomed either to further destruction by tubal drainage of the parenchyma proper or to removal.

Conservation is the keynote of this war and the adoption of this surgical measure will conserve our most valuable asset—lives.

THE ENTRANCE OF AIR INTO THE MEDIASTINUM DURING OPERATIONS ON THE BASE OF THE NECK¹

B. COITMAN (BUFFORD, MD.) AND S. CHASE

WHEN dissections are made at the base of the neck exposing the jugular vein not infrequently suction sounds are heard with each inspiration. These sounds are caused by the entrance of air into the cellular tissue. It has always been my practice to pack this area with moist gauze tucking it under the inner end of the clavicle. This procedure promptly puts an end to the sounds.

A few days ago I was called to see a patient after he had exposed the jugular vein through the skin over the clavicle and a removal of the tubercular glands from the jugular sheath. He then tied the skin over the wound. We packed the wound. Later in the operation the pack gave a lodgment again entered in large amount. I promptly tied the wound with a turban. I respiration unsatisfactory. He was coughing and extremely cyanotic. Henceforth the patient lay badly that the operation was abandoned. He awakened and complained of air hunger and pericardial pain. The respirations were shallow and painful. Her condition was very grave and I understood that the cause of his trouble was not a gas embolism. Dr. Henry I. Mill saw him in consultation making a diagnosis of emphysema of the mediastinum. Her convalescence was slow for several days but she left the hospital about the usual time.

On July 26, 1916, I operated upon Mr. A. for a large adenoma of the thyroid gland. He was a well-nourished German 44 years of age and appeared to be in good health aside from the goiter and mild toxic symptoms accompanying it. Ether anesthesia was used. A transverse incision was made at the base of the neck, the skin and subcutaneous tissue dissected back above and below and muscle split, using rather than transverse muscle section carried on through the muscle planes. The tumor occupied the lower pole of the left lobe and after freeing it almost completely by finger dissection, finding I needed more room, I further pulled apart the vertebrae of the sternum and sternothyroid plane. At once suction sounds were heard with each inspiration, not so loud as I am accustomed to hearing here, no symptoms ensued. Before I could secure a pack to insert the patient appeared to be rousing from profound narcosis, stiffened his whole body, held his breath and a paroxysm of coughing set his jaw and became erythematous. I immediately took these manifestations for poor management of the anesthesia. The operation was temporarily interrupted and for fully 10 minutes unsuccessful efforts were made to induce profound anesthesia, hoping to overcome his cough. This difficulty appeared to be due to his halting and infrequent breathing. By covering the ether his coughing almost ceased and he was sufficiently narcotized to allow the operation to be hurriedly completed. After closing the wound Dr. J. W. Clark removed his tonsils without further serious respiratory difficulty. The patient left the operating room this morning.

was put to bed pale and unduly moist with perspiration. His fingers were cyanotic, pulse 112, regular but very weak, respiration 24 and his condition not very serious. As he began to awaken little paroxysms of coughing followed almost every inspiration, each leaving him a little more cyanotic. He continually tossed about in bed and when further awake complained of air hunger, great precordial fullness and precordial pain with each inspiration greatly accentuated by deep breathing. As he grew more cyanotic venous blood exuded from his tonsillar wounds. His voice was weak, eyes sunken, expression anxious and he later sat up in bed struggling for air, a terrible picture of suffocation. At 6 o'clock his temperature was 100, pulse 126—regular weak respiration 6 shallow. At 6:30 pulse 140, respiration 8. At 6:45 pulse 155, very weak respiration 34. At 7 p.m. I was called by the interne who feared he would die before I reached the hospital and on examining him I found emphysema of the subcutaneous tissue at the front and left side of the neck extending down over the upper third of the middle and left anterior surface of the chest. There were also typical deep emphysematous clicks originating in the superior and lower mediastinum. These were distinctly heard immediately around the heart with both systole and diastole. The heart was extremely tumultuous. I at once concluded that his trouble were due to emphysema of the mediastinum. Although he had $\frac{3}{4}$ grain morphine with $\frac{1}{150}$ of atropine before going to the operating room an additional $\frac{3}{8}$ grain morphine did not benefit him. Between 6:45 and 7:30 his pulse could not be counted and from 7:30 to 8:30 ranged from 165 to 180 when it could be gotten, respiration about 44, very shallow and irregular. Fresh air, oxygen and digitalis products did not benefit him. It looked as if he would shortly die. I then removed 15 ounces of blood from his median basilic vein. His cyanosis cleared a little but not as much as I expected. On the other hand his breathing became far more comfortable and I was surprised at the degree of relief obtained. His pulse became more full at once and ranged around 150 and throughout the night he continued to improve. His improvement dated immediately from his venesection. At 6 a.m. the following morning his temperature was 100 and pulse 132—respiration 4. I then felt certain of his recovery. At 2 p.m. his temperature was 100, pulse 100, respiration 24. After this he had a little temperature for several days, pulse ranging about 100. For at least a week it was observed that his breathing was labored, his clavicle and scapula making very wide excursions with each inspiration and cyanosis was still present but gradually disappearing. It was at least one week after the operation before all the air clicks had disappeared from his mediastinum, those about the heart lingered the longest. While his convalescence was otherwise undisturbed I must call attention to the fact that he still showed sunken eyes and cheeks and considerable pallor for two or three months as

a result of this severe cardiac jar. In other words he did not seem to come back.

I have also seen one patient with fractured ribs on the left side which penetrated the lung. Emphysema of the chest was noticed the day of the injury. The following morning air had reached the anterior mediastinum and from the depth of the emphysematous sounds and their relation to the cardiac area and the heart movements and the grave cardiac disturbance I inferred the air had extended to the middle mediastinum as it seemed to have done in the patients previously referred to.

The symptoms and course of all these patients were almost identical.

From these experiences we may be certain that when sufficient air enters the superior mediastinum during operations on the anterior surface of the base of the neck, certain definite grave symptoms similar to those of suffocation suddenly occur and the clinical course will be pretty uniform. In such operations efforts should be made to prevent this accident and when it occurs prompt consideration given it. The surgeon must then decide whether the operation is to be continued or abandoned and what if any treatment is to be adopted. The literature abounds in references to the possibility of emphysema of the mediastinum in accidents to and operations on the trachea and all the upper respiratory passages but thus far search through the literature has revealed nothing descriptive of this accident and its symptoms in connection with operations at the base of the neck. I am of the opinion that it occurs much more frequently than is supposed and that the grave symptoms are credited to the anesthetic. The accident appears to occur because we disturb structures of the neck in their mediastinal location where the cellular tissue is opened and air is aspirated. Among my observations one occurred through following down the internal jugular into the superior mediastinum, the other through separation of the sternothyroid and sternohyoid plane to their origin which is in the superior mediastinum. From illustrations in Gray's *Anatomy* of cross and vertical sections of the chest and from my own experiences I infer that when a small amount of air enters the superior mediastinal cellular tissue it may create no disturbance but as

larger amounts are drawn in the air passes downward through the cellular tissue immediately behind the sternum to the anterior mediastinum and then finds easy egress backward into middle mediastinal chamber where it lies next to and may entirely surround the pericardium. In my lung wound reference I infer the air extended through the cellular tissue lying just outside of the parietal pleura to the anterior and from there to the middle mediastinum. The symptoms have been sufficiently enumerated in the case history but I must impress upon you that the precordial pain is most intense.

It seems quite apparent that the irritation of the foreign air of a lower temperature would be sufficient to induce reflex coughing, through direct irritation of the right and left phrenics which lie in the space invaded by the air in the middle mediastinum and also through contact with the outside of the parietal pleural reflexion or mediastinal pleura which surrounds the pericardium and the presence of air in the neighborhood of the pericardium and the pressure that it induces about the heart would disturb its delicate nervous mechanism and its free movement and thus account for the rapid erratic and tumultuous heart. I infer from the published advice of many to incise the mediastinum for serious symptoms induced by emphysema due to wounds of the respiratory tract that where we have closed wound and the air is thus retained the temporary disturbance is greater than in those cases where wounds in the mediastinum have been left open thus giving free egress to the air. It thus seems to me that

the condition differs in its likely outcome from wounds of the trachea and upper respiratory passages from which there may be a continuous supply of air to the mediastinum with increasing irritation and pressure symptoms and frequently resultant death.

The sudden partial awakening from an apparently profound narcosis is probably due to severe cordial pain quite comparable to true angina. It is likely that after the first symptoms of suffocation have passed the anesthetic may be pushed with benefit in some cases and the patient profoundly narcotized and in most cases operations of short duration may be completed.

In the treatment of this condition I feel that free ventilation of the room and oxygen are indicated that possibly digitalis products are beneficial. In the graver cases venesection offers us more relief than anything else. If after venesection there is still no relief incision of the anterior mediastinum has been recommended in somewhat parallel conditions. The wisdom of this is debatable because it is possible that instead of relieving tension more air might be admitted and the symptoms aggravated. This question need to be settled by animal experimentation. If incised the edges of the wound should be kept apart by stiff rubber drains or other methods but at no time should gauze be used for that purpose because it becomes filled with blood and soon plugs the wound. It also remains for us to determine by experimentation what if any relief may be obtained by very slow aspiration of the anterior mediastinum through needle puncture.

PROBLEMS IN ABDOMINAL SURGERY¹

By THOMAS J. WATKINS, M.D., I.A.C.S., CHICAGO

THIS paper will consider in abstract problems commonly encountered in gynecological surgery which have been of special interest to me and which I hope will interest you and stimulate profitable discussion.

Prevention of postoperative shock and neurasthenia. The work of Crile upon these subjects has been an important contribution to abdominal surgery particularly as regards fear, fright and unnecessary traumatism of tissues.

It is important to avoid scaring the patient with a serious or hopeless prognosis. Starvation and purging before operative work weakens the patient, disturbs the digestive system and impairs blood coagulation. Good sleep and the use of morphine and scopolamine before operation does much to relieve nervousness and fear. Our custom is to give bromide the night before operation and a hypnotic if necessary for sleep. Forty-five minutes before operation $1/6$ to $1/4$ grains of morphine with $1/150$ grains scopolamine is administered hypodermically. This allays nervousness and fear and commonly the patient sleeps while waiting for operation. These doses never produce the alarming symptoms which at times follow larger ones. It also materially aids the anæsthetic.

The best anæsthetics I have seen were given in Crile's clinic and have committed me to the use of gas oxygen anæsthesia with ether as needed in nearly all cases.

Our results from infiltrations with novocaine and quinine urea as advocated by Crile were disappointing. We were unable to observe any benefits from their use; they added somewhat indirectly to the dangers of infection and were discontinued.

Local anæsthesia is valuable in some cases; it teaches the operator much about the sensitiveness of the abdominal viscera and develops gentle surgery. A general anæsthetic is no license to unnecessarily traumatize tissues.

Ether by the drop method continues to be

the safest general anæsthetic for the untrained inefficient anæsthetist. Selection of the anæsthetizer is more important than selection of the anæsthetic.

Observation shows that neglect to protect the wounds from contamination from the surrounding skin is common, more common in this country than in the leading European clinics. No one would contend that the skin can be made surgically clean, but fortunately the bacteria of the skin are usually of not much pathogenic importance, not usually enough to prevent primary union, though they must occasionally produce peritoneal adhesions. To leave iodine on the skin and to rub it into the peritoneal cavity during the operation as is often done must add to peritoneal irritation and be a factor in production of adhesions.

Rubber as a substitute for the gauze roll and pads in the abdomen. The papers of Bruns made of Brooklyn and Keith of Providence upon the use of rubber instead of gauze to prevent abdominal adhesions were of much value. Following Bruns' made a paper which appeared first; we have been studying the subject and now use rubber as a routine almost to the entire exclusion of gauze. We are using thicker tissue than they advised, the rubber being the thickness of heavy rubber gloves. It is used in pieces 18 inches wide by 30 inches long. The heavier rubber does not roll up in wads and the weight of the rubber aids in keeping the intestines out of the way.

The difference in the amount of traumatism to the peritoneum produced by rubber and gauze must be so self-evident that experiment and argument are unnecessary. In the majority of cases of abdominal surgery the rubber tissue permits the operation to be done without the use of any gauze in the abdominal cavity and without added inconvenience.

Is it better to sponge out or to leave fresh blood in the abdominal cavity? This would logically apply to clean cases only. In the earlier days

be mentioned here. It is more practical and more profitable to review some of the foreseeable and sometimes preventable instances of asphyxiation that occur as accidents or incidents of delivery.

So long as the bag of waters remains intact the danger to the babe is extremely slight except through overlong persistence of the membrane or through intra uterine interference with the cord. This mishap is of course possible at any stage of the pregnancy or labor but it is far more liable to occur before the onset of the pains.

As soon as the membranes rupture however the fetus is exposed to danger. Immediately the uterus becomes smaller the contractions harder and more frequent while the gas exchange between mother and child is doubtless greatly restricted. The longer the contraction the shorter the pain free interval the greater the danger to the child.

Besides there is a marked change in the intra uterine pressure. The diminution that comes on directly after the rupture of the membranes is replaced through the reduction in the size of the organ by a decided increase.

If the column of mercury stood at 80 before the event says Schultz it rises to 150 or more after the liquor amni escapes.

Usually this pressure is equally distributed over body and head and in normal labors is of no particular consequence but in certain instances where the membranes rupture prematurely and in oblique presentations serious results will follow. In the cases as well as in presentations of the pelvis face and brow where a limb is prolapsed beside the head or in pelvic contraction certain parts of the uterus are put under a higher degree of pressure than other portions. This happens occasionally from contact with the irregularly disposed fetal parts or from stimulation of the uterine musculature with localized contractions. An alteration of the blood supply ensues and oxygen starvation begins in the fetal blood while retention of carbon dioxide increases. Under the same conditions compression of the cord or of the placenta may occur or the spongy placental site may be contracted to a dangerous degree. The definite reduction in the volume of the uterus

may also react in a manner perilous for the fetus.

The soft parts that bound and reinforce the genital canal normally offer a serious resistance to the passage of the unlucky child and this resistance may be greatly intensified by unusual conditions in the mother or babe. Even physiologically there exists a significant difference in this resistance between the soft parts of primiparas and multiparas.

In the first labor a marked opposition arises from the integrity and rigidity of the muscles connective tissue and elastic structures of the pelvis and especially of the pelvic floor. This finds outward expression in a prolongation of the labor in particular of the second stage and is associated with an increase of danger to the babe not only from detention but from pressure. It is generally taught and statistics seem to confirm the belief that three times as many stillbirths occur among primiparas as among multiparas.

To these danger factors several contributory factors may be added. Thus the primipara may be over thirty years of age or the child may be a male. Then too an unfavorable presentation or a difficult position as well as a necessity for operation may increase the peril materially.

That the tissues of an old primipara are less elastic and the labor somewhat longer is commonly recognized among obstetricians even in the absence of pathology. But in appreciating these cases we are more likely to estimate the danger to the mother and to minimize or to disregard the peril to the child.

Nonetheless there is a real hazard to the babe in prolonged labors. In proportion to the duration of the second stage it is found that among the deaths primiparas with a stage of one hour furnish 8 per cent and over two hours 18.3 per cent while for multiparas the average is one third less. In another series of 2550 vertex labors reported by Veit in which the second stage lasted two hours or more it was found that in the two hour cases 18.3 per cent were born asphyxiated 17 per cent were stillborn and 5.5 per cent died later. Among the four hour cases 49.65 per

cent were asphyxiated 5.59 per cent were stillborn and 6.7 per cent died during the next few days

Statistics also show as we would naturally expect considering the presentations in gross that the vertex is least and the transverse is the most dangerous (39 per cent). Personally some surprise was felt on finding that a face presentation was (13 per cent) only a trifle more than half as dangerous as a breech (21 per cent).

This is due as we understand it to the fact that the head is the largest and least compressible part of the child's body. Hence as it advances the canal is slowly dilated the power of the uterine contractions is definitely increased and when the head is born the rest of the body follows quickly. On the other hand when the smaller and softer breech precedes less powerful pains are required and the progress is deliberate. The thorax and finally the head finds the passage imperfectly dilated and the pains not yet developed to full strength. Retardation of the upper half of the body takes place while the lower part is delivered. A pause ensues in the course of the labor. A moderate pause in vertex cases is of no particular consequence since the cord ordinarily is not compressed and the child's mouth is free. In breech cases on the contrary the cord is compressed and the child's mouth is surrounded by liquor amnii or else buried in the soft tissues of the passage. Under these circumstances the child becomes asphyxiated in a few minutes and in from eight to ten minutes will die for as soon as the umbilicus passes the vulva the cord is squeezed between the pelvic brim and the large head and shoulders of the child and extraction must not be delayed.

Moreover in vertex cases it is just as important to guard against too great compression of the head as against the excessive prolongation of the labor for while compression of the skull in the absence of such injuries as arterial rupture and lesions of the brain does not of itself produce death yet it may directly contribute thereto by bringing about a paralysis of the respiratory center. In breech compression this center becomes obtunded and so retards the mechanism that

no effort at inspiration is made prematurely. Now while this quiescence in the respiratory phenomena may be advantageous sometimes in protecting the child against the aspiration of mucus or liquor amnii it more commonly happens that a permanent paralysis takes place and after the conclusion of the labor when the oxygen from the placenta has been shut off a child with a good heart beat and a good circulation cannot be made to breathe in spite of the most persistent and conscientious effort. The babe becomes asphyxiated as soon as it is compelled to depend upon atmospheric air and its own inspiratory exertions. This condition is by no means rare for in many cases of foetal death there is no evidence postmortem of premature attempts at respiration nor of positive lesions in the skull such as depressed fractures or blood effusions. In fact most babies that are born in asphyxia and are afterward resuscitated are examples of skull compression.

According to the degree of foetal prostration these cases are usually divided into blue asphyxias and pallid asphyxias. Blue babies represent a minor grade of the condition and are therefore the most hopeful to work over. In fact we are not altogether sure that blue babies are markedly abnormal for the hypercarbonization of the blood or more accurately as Carlson contends the retention of acid products which produces this blueness is a necessary preliminary to respiratory activity. The normal stimulus to the respiratory center must be sought in the tidal fluctuation in the alkalinity of its blood supply which in turn is due to carbon dioxide and lactic acid formation. The child does not breathe because it needs oxygen but the accumulation of carbon dioxide results in a relative acidosis of the blood which irritates the breathing center. It reacts and oxygen is taken in.

In pallid asphyxia however the reflexes are lost the muscle tonus is gone the cord is collapsed and almost pulseless while the heart beat is feeble and irregular. In fact the child has passed from vagus irritation over to vagus paralysis from which it is only occasionally rescued.

Boys suffer from asphyxiation more frequently than girls either because as a rule

they are larger and therefore have longer and more difficult labors or because more boys are born than girls or possibly from both of these conditions. In this connection it is pertinent to note that Simpson found the second stage to average 1 minute longer for boys than for girls.

Contracted pelvis is another cause of foetal asphyxiation for in this complication we not infrequently have the association of a premature rupture of the membranes stormy pains prolonged labor changes in intra uterine pressure and cerebral compression.

It must not be forgotten that a certain slowness in the expulsion of the child is usually propitious. The pain free interval is then sufficient for the continuance of placental respiration and the gradual conquest of the pelvic opposition takes place by a non injurious adaptation. Brain pressure symptoms appear only when the nourishment of the cerebral tissue is interfered with through anæmia or hypervæmia. So long therefore as the placental circulation is maintained and in no way diminished or cut off by tetanic contractions medically induced or otherwise danger can only arise through paralysis of the breathing centers when the head is exposed to hard or prolonged compression. Moreover if the child is feeble or already on the verge of extinction through a moderate or a protracted compression it is easy to see how the application of forceps could bring the disaster to completion. Pure cerebral compression occurs only when in operative deliveries the child is drawn by feet or forceps through rigid soft parts or a small pelvis. The cases of asphyxia after hard forceps deliveries are thus explained. The slowing of the heart tones from cerebral compression during the forceps operation can be readily demonstrated if the stethoscope is applied while traction is made.

Ahlfeld brings forward the logical theory that delivery of the child into the vagina with a consequent recession of the uterus over the breech may produce so great a contraction at the point of placental attachment that the babe may be asphyxiated in a short time if the end of the labor is not hastened.

To summarize then we may say that large

babies rigid inelastic soft parts premature rupture of the membranes artificial extraction by feet on forceps version moderate pelvic contraction prolongation of the labor or any other condition which can bring about cerebral compression may be regarded as a determining factor in asphyxiation of the babe. Maternal coma lung œdema spasm of the respiratory muscles premature separation of the normally implanted placenta (only one in 15 lives) and placenta prævia (50 per cent die) all result in foetal suffocation by an obvious process. Even the hæmorrhages from a lacerated cord or traumatized arteries are really forms of asphyxiation by a legitimate extension of the term.

We now come to a question that has long been in the background of our minds. What asphyxiating effect if any is produced on the babe *in utero* by an anæsthetic?

Since 1902 this subject has remained more or less uneasy under the dictum of Ballentyne who stated. While there is evidence to show that chloroform may pass over and enter the blood of the *fœtus* after prolonged administration to the mother there is no strong evidence that when there it produces any serious effects. As with chloroform so with ether. Its transmission through the placenta if not entirely proved is probable but there is no reason to apprehend a toxic effect unless the anæsthesia be very deep or greatly prolonged. Preyer has shown in his experiments with curare hydrocyanic acid and nicotine that in asphyxia of the mother animal the blood of the umbilical vein of the *fœtus* becomes markedly dark in appearance indicating that oxygen is being drawn from the *fœtus* to the maternal organism. It is clear therefore that if anæsthetics are administered for a long time the *fœtus* may be seriously endangered and if administered up to the point of saturation the *fœtus* may be killed. It is quite plausible also that injurious effects will appear earlier or follow a smaller amount of anæsthetic if the patient is organically diseased or toxic.

Davis of Chicago has recently become interested in this subject through his enthusiasm for gas analgesia in labor. His experiments on pregnant guinea pigs have

brought him as we interpret his careful work if not to the same at least to nearly the same conclusions as Ballentyne Davis finds that gas and chloroform are more dangerous to the fœtus than ether but that all anesthetics have their dangers when the administration is continuous or long maintained In his opinion the intermittent use of gas say four or five whiffs at the beginning of each pain and properly mixed with oxygen can be carried on for a considerable time without injury to the child

His argument it seems to us applies equally to ether and chloroform These also may be given for a considerable time with safety if given in the way he prescribes for gas In all cases the vapor has been largely eliminated by the end of the contraction and the normal metabolism is not disturbed during the interval There is a pervasive elimination of the absorbed gases most rapid necessarily in the case of nitrous oxide in which the emunctories of the body must be aided appreciably by the support and energy imparted to the circulation by the powerful pump like action of the functioning uterus

The subject of anesthetics would not be complete without some reference to twilight sleep where the accusation of injury to the babe is so commonly heard Morphine scopolamine analgesia definitely controls the pain of the first stage and carries the patient well into and frequently through the second Unquestionably a small proportion of the babes must be in condition to take up the infinitesimal part of the elaborated toxin which might pass over in the maternal blood But as we have seen in the case of other pain relieving agents so in this the blood of both patients is competent to purge itself though not so freely nor so quickly as from the anæsthetic vapors Blue babies occur just as often under twilight as without it but no more so

Masses of statistics are not yet available but observations seem to show that no disastrous effects follow the morphine scopolamine method unless the treatment is begun too late or the dosage is too large or too long maintained

Excluding multiparas with worn out uterine

muscles we find that old primiparas and women with small genital canals women with rigid inelastic soft parts and women with highly sensitized nervous systems are the ones who have protracted labors They will not or they cannot use the abdominal muscles to hasten the process In these women we find all the conditions present for an asphyxiation of the child from prolonged cerebral compression either moderate or severe Furthermore it is just these women who cry loudest for anæsthesia and forceps They very properly get both but when the child is born and fails to breathe suspicion is bound to fall upon the anæsthetic or upon the instruments no matter how skillfully or how judiciously they may have been used

We are left therefore in the belief that any anæsthetic which is continuously administered for a long time may be injurious or even fatal to the child in the manner shown by Preyer in his experiments with curare and nicotine On the other hand we are inclined to believe that any anæsthetic may be safely used if it is given under proper indications for a relatively short time and intermittently

A word is necessary regarding pituitrin It is difficult to overestimate the value of this substance in modern obstetric work and yet fœtal death may swiftly follow its ill advised exhibition In the roomy unobstructed pelvis of a multipara who has weak shallow and inefficient contractions in the second stage pituitrin is a gift from heaven But where the babe is already advancing laboriously and is somewhat stunned by the hardships of the way where the os is incompletely dilated or some obstacle to progress exists the attempt to hasten delivery by the use of pituitrin may bring on tetanic contractions of the uterus and eliminate the pain free interval for a period long enough in some cases to close the placental circulation and asphyxiate the babe So powerful an agent must be used with extreme caution Its slowing effect upon the fœtal heart tones is easily observed

On the postmortem changes we need to dwell but a moment They are quite as variable as in adults There are some phenomena however that are fairly constant The subpleural and subpericardial ecchymoses

are nearly always present. They follow as we believe the strong inspiratory efforts of the suffocating fetus when the placental circulation is interfered with. There is a sudden and marked enlargement of the thoracic spaces in which the blood drives furiously and in which in many instances necessarily it bursts through the tender capillary walls.

Liquor amni vernix caseosa or meconium may at times be aspirated into the trachea for premature attempts at respiration will inevitably follow the hypercarbonization of the blood.

The diagnosis of fetal death previous to birth is not always easy to determine unless the patient has been under observation before the labor began. The discharge of offensive liquor amni after the rupture of the membranes is not always significant. The presence of meconium in the discharge may or may not be important although in some cases the occurrence is justly interpreted as due to a relaxation of the sphincter which arises from an irritation of the submucous ganglia of the intestines through a hypervolemia of the blood.

The most definite and reliable information as to the condition of the child is obtained from the fetal heart tones wherein the signs of cerebral compression and the effects of hypercarbonization of the blood on the vagus are duly registered. Throughout the second stage the heart tones must be counted at frequent intervals and care should be taken to observe them before, during and after a pain to be sure that the normal rhythm is resumed. The neglect of this precaution may result in the birth of a dead babe that in some instances might have been saved.

Signs of danger are recognized when the heart beat is greatly diminished or markedly increased, also when an increase in frequency is followed by a retardation. The injection of pituitrin is regularly succeeded by a reduction in the heart beat, but unless the dosage is too great and the uterus remains contracted too long or unless the child is already weakening under the adversities of the labor, the heart soon resumes its normal rhythm and strength.

We may say then that the danger signs are

really only three: the slowing of the heart beat, its increased rapidity and its irregularity.

Slowing is the most common phenomenon and in the absence of pituitrin is almost pathognomonic of carbon dioxide intoxication (or acidosis) with irritation of the vagus. It is pathologic however only when it persists during the pain free interval. Normally it should regain its regularity, volume and rhythm as soon as the contraction passes away. If it sinks below a hundred (100) in this interval, danger unpendes and the labor must be terminated.

The next stage of intoxication is shown by a further involvement of the insulated vagus which speeds up the heart to 160 or more beats per minute. The child is now seriously imperiled and delivery is imperative.

The third degree of intoxication is signalized by the irregularity of the heart beat which means paralysis of the vagus. There is of course a maximum and a minimum variation normally occurring during the contraction and in the pain free interval but when this variation exceeds 50 beats interference must be attempted in behalf of the child. The cessation of heart tones previously heard clearly is manifestly diagnostic of fetal death.

It is not germane to this paper to discuss the generally familiar methods of resuscitating an asphyxiated infant. Fetal death is confessedly a failure and a disappointment. The treatment should aim at prevention and we shall therefore lay stress upon the precautionary measures which constitute our scientific prolepsis. At the risk of tediousness we must again emphasize the reliability of the fetal heart beat as a danger signal; it behooves us to keep it under close observation.

The objection to the frequent auscultation of the heart tones is very properly based on the disturbance of the clean linen with a consequent contamination of the sterile field but this risk can be minimized by the use of a sterile receiver on the stethoscope and then by having another person either use the instrument himself or else slip the ear tips into the ears of the operator. At all events if the patient is an old primipara or if for any reason the second stage is unduly prolonged the heart tones must be carefully controlled.

If pituitrin is given the dose must be small not to exceed 10 minims and the effect should be followed with the stethoscope

If an anæsthetic is required and ether or chloroform is chosen let it be given *a la reine* and as little as possible. No anæsthetic should be given for more than three consecutive hours without stringent indications. If gas is used we believe with Ferguson that re-breathing should not be permitted for it is dangerous to the child. If the woman is toxic or has a high blood pressure neither gas nor chloroform is admissible. If morphine scopolamine is employed the woman must be at least three hours away from the end of her labor.

When the condition of the heart tones indicates danger the fate of the child will depend upon the possibility of an immediate natural or artificial delivery which may or may not save the child. If the delivery is artificial whether forceps or version it is occasionally necessary to complete the dilata-

tion of the soft parts with the hand before beginning the extraction. The operation is justified by the imminence of the peril.

If the subaeration of the blood is partial or only temporary the child may be resuscitated but if the heart does not beat the respiration can scarcely be established even though the head be released from pressure.

In conclusion furthermore we must add that while the babe may be stimulated to breathe by one or all of the usual methods of resuscitation the prognosis is not yet altogether favorable since our statistics show that from 10 per cent to 15 per cent of babes born in asphyxia die during the next eight days. The fatality generally results from a continuing atelectasis from convulsions paralysis pneumonia or some form of physical incompetence which prevents the natural and welcome readjustment after birth. Nevertheless the frequent appreciation of the foetal heart tones is the surest criterion of foetal safety.

INTERSTITIAL PREGNANCY ADENOMYOMA OF THE RECTO VAGINAL SEPTUM¹

By ARTHUR H. CURTIS, M.D., I. A. C. S. CHICAGO

INTERSTITIAL PREGNANCY

IN 1913, in the *Revue de gynécologie* Wiegeli presented an exhaustive summary of the literature on interstitial pregnancy. All told, including brief reports from society proceedings, he found mention of 150 cases. Of these only 53 could pass muster as authentic instances of this type of gestation.

Three features characterize interstitial pregnancy—the fundus is more vertical, the round ligament is inserted lateral to the sack, and the tubes are asymmetrically inserted on the fundus of the uterus.

Rupture tends to occur later than in other pregnancies. An authentic case of rupture into the uterine cavity has not been reported.

The specimen of which I show you photograph is from a young woman of . . . The patient came to me because of incontinence of urine. She has one

child aged 2. In a subsequent pregnancy a foetus was lost spontaneously in the ninth week. The history was otherwise normal except that her menstrual



I (at left) Fundus of uterus containing interstitial pregnancy viewed from behind. Specimen consists of right half of fundus with uterine end of right tube. The portion of the uterus was elevated nearly an inch above the remainder of fundus from which it was cut.

I (at right) Interstitial pregnancy viewed from above. The cutting thus called hemorrhagic uterine or the sack, the rupture as imminent.

ADENOMATOMA OF THE RECTO VAGINAL SEPTUM

Until the recent excellent work of Cullen this affection remained but little known. Cases should be reported not so much because of their rarity in the literature as because they are *not* rare in practice but have remained unrecognized.

The tumor spring most commonly from the region of the cervix and grow posteriorly invading the cul de sac and the adjacent invagination occurs much as in carcinoma but less malignantly.

I have had two cases. One has not been operated upon and is still under observation. Photograph of the specimen from the other patient are presented.

When first seen in January 1914 the patient was an Oak Park school teacher, 40 years of age. There was a history of menorrhagia for many years bearing down distress and constipation.

Upon examination were found a congenital ring in the vagina and a large uterus fixed in retroversion. In addition a long polyp-like bean sized nodule projected downward evidently from the cervix into the cellular tissues of the posterior cul de sac.

The offer of a wealthy aunt to defray all expenses persuaded the patient to go East for operation. A month later she returned in most excellent condition minus the bleeding fundus but still possessed of the cervix and the small nodule. This mass examined every few months remained unaltered until one year ago. Then began a lot growth with gradually increasing rectal distress during the next 6 months. Now development became more rapid and in two months time the tumor doubled in size invaded the vaginal septum and burst through the vaginal wall into the posterior fornix. There was associated vaginal bleeding.



FIG. 6 Adenoma in vagina and uterus under till lower magnification (1 diameter).

The cervix together with the tumor mass and invaded tissues was removed by the vaginal route. The growth was adherent to the rectal wall but did not invade it. Recovery was prompt and complete.

Study of the preserved specimen and of the enlarged photographs of the fresh specimen taken immediately after removal show no discernible line of demarcation between the cervix and the tumor mass.

In the photomicrographs from four various portions of the tumor the typical adenomatous character of the growth is at once evident.

DEPARTMENT OF TECHNIQUE

INTERILIO-ABDOMINAL AMPUTATION A DESCRIPTION OF A NEW METHOD

WITH A REPORT OF THREE CASES

B W WAYNE BABCOCK MD FACS I LADLE A

Plastic Surgeon, St. Louis, Mo. S. S. M. C. So. d. Am. S. Mach. Ho. p. l.

NO more unsatisfactory result follows amputation than the femoral amputation through or above the hip joint for malignant disease. After amputation for periosteal sarcoma of the femur recurrence during the first year have been almost invariable. The removal of the leg and thigh for malignant epithelial growth has likewise been followed in most cases by early return of the tumor. If one add the large secondary mortality to the primary mortality he may well question the advisability of the high amputation for malignant disease. If however one contrasts the technique used in extirpating malignancy of the leg with that successfully employed against malignant tumors of the breast or certain other organs he must be impressed by the fact that in the amputation the first principle laid down as essential in the eradication of carcinoma are

not complied with. If the old simple amputations of the breast for carcinoma were usually futile because they were not sufficiently radical may not the present hip joint amputations for malignant disease fail because they are not sufficiently radical? Consider the conventional method of hip joint amputation as that of Wyeth Furneaux Jordan (Fig. 1) Kocher (Fig. 2) by the anterior racquet incision (Fig. 3) and even though by the interilio-abdominal method as that of Keen (Fig. 4) and it is evident that none is radical or complete as regard our present concept of infiltration in malignant disease or its dissemination and permeation along the lymphatic and fascial plane. Moreover none of these amputations is a complete removal of the leg and thigh. All leave large flaps of skin from the upper thigh and in none is the superficial lymphatic area of the groin and the deep pelvic lymphatics



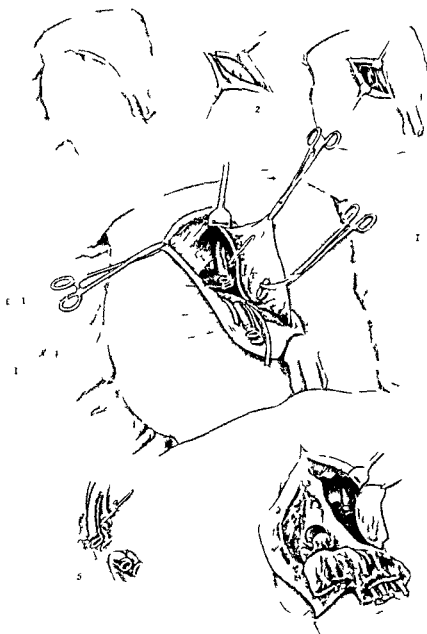


Fig. 6 No. 1 First incision. Plan of flap and second incision indicated by dotted line.

Fig. 7 No. 2 Primary incision deepened. Iliac vessels, inguinal lymph nodes, the superior vena cava, and deep epigastric artery, *E*, being secured and divided.

Fig. 8 No. 3 The peritoneum is exposed, the femur is infiltrated and divided.

Fig. 9 No. 4 The peritoneum is freed and retracted well up and in the position of the side of the pelvis and the iliac bifurcation. Just below the bifurcation the external iliac vessels are doubly ligated and divided. A provisional clamp placed on the internal iliac artery thus controls the circulation. The iliopectineus is divided high and the lower portion with adjacent areolar and lymphoid tissue stripped down. *C*, the iliac fossa and the lateral aspect of the pelvis to the bone. *C*, Anterior crural (femoral) nerve. *S*, iliopectineus. *E*, iliac artery and vein. *C*, external iliac artery and vein. *L*, ureter. *S*, spermatic cord.

Fig. 10 No. 5 Detail showing the clamp on the internal iliac artery and the divided external iliac vessels.

Fig. 11 No. 6 The skin flap is partially formed by a conical incision and kept open to the bone. The flaps include all of the parts of the femur, the acetabular cavity, opened and the head of the femur articulated. *G*, Gluteal artery. *A*, iliopectineus. *F*, iliopectineus. *I*, iliac artery and vein. *D*, iliopectineus. *S*, spermatic cord.



F N Th sk fl p mpl t d d tl d p t f th b ttock
 d d d ft e po g d nhlt t ng th c t n h h m t t
 ft th d t l t S N S t
 f 3 N Sh l f post k th m d som hat
 l h l th t b ct d m d
 F 4 N Amp t t mpl t d Th t mp f tl i p t d
 t th d f th t l bl q d t n l f m g d l gh
 b l m l l S S t f t t ry T t nd n fl m t g
 r r N A M c l t u fl I t d l j th l t ly l t
 o The d f th gl t l m l ut d t th dge f tl t rnal blu
 r f th bd m l ll D a g d by m ll t b f m th pel
 th gh t b d th l pe d t p rt f tl fl p
 Fig 6 N b P t l m t t Th dly d t th
 d y mp t t
 F N b l t n f bo m d
 F 8 N 3 l C m l t d t mp fte mu t t D a t l t
 f th n m at f m l t mp

below the bifurcation of the a rta removed Surely for carcinoma and probably for sarcoma of the lower extremity the routine use of more radical and complete operation should be tri d

As for the y tematic radical amputation herewith described our experience is limited to three very advanced cases of n aligancy of the le complicated by pelvic metastasis All even

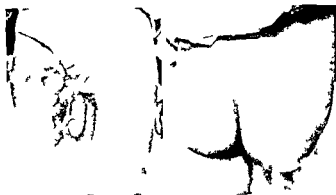


Fig 19 Case 1 interilio abdominal amputation bone not removed Anterior view of stump

Fig 20 Case 1 posterior view of stump



Fig 21 Case Interilio abdominal amputation re section of pelvis appearance of stump

Fig 2 Case Posterior view



tually succumbed yet there was much to suggest that the operation might have availed had it been employed earlier in the course of the disease. In each case as considerable tissue was removed above the level of the ilium we shall employ the term interilio abdominal amputation although in one case none of the innominate bone was removed (Fig 5). In the second case about one half and in the third case all of the innominate bone was taken away. In other respects the technique was similar in each case. In each spinal anaesthesia reinforced by narco local anaesthesia or nerve blocking in the wound was employed. The method however lends itself especially well to local or narco local anaesthesia alone. The amputation is of the enucleation type and embraces the following features:

- 1 The practically absolute provisional haemostasis without additional incision or special apparatus

- 2 The facility with which the amputation may be carried out under local anaesthesia with a minimum of shock

- 3 The removal of all the skin and deep tissues of the thigh the flaps being formed above the level of Poupart's ligament and the gluteal fold

- 4 The removal *en masse* of the amputated part the lower abdominal wall the inguinal and deeper pelvic lymphatics with the adjacent fascial planes and soft tissues

- 5 The restoration of a strong abdominal floor and anterior abdominal wall

- 6 The use of a single relatively small posterior or postero external flap with ample blood supply

- 7 If necessary the removal of part or all of the innominate bone

TECHNIQUE

The first incision (Fig 6) starts about four centimeters above the spine of the pubis is curved upward to a point almost eight centi-

meters above the middle of Poupart's ligament and ends about four centimeters above the anterior superior spine of the ilium. If there is inguinal gland enlargement or infiltration of the skin of the inguinal region the first incision is so modified as to be well above the infiltrated area. Lifting the upper skin edge the fat is undercut so as to insure its removal to a level several centimeters above the skin incision. The incision is here deepened to the aponeurosis of the external oblique and fat and fascia stripped down to a point about six centimeters above Poupart's ligament where the incision is deepened to the peritoneum the superficial and deep epigastric and the superficial circumflex iliac arteries being exposed tied and divided (Fig 7). The peritoneum is now stripped from the hollow of the ilium to a line well over the brim of the pelvis and a point as near the bifurcation of the aorta as possible. If infiltrated the peritoneum is resected and the opening at once closed. Usually the peritoneum is not opened (Fig 8). In women the round ligaments should be ligated and divided at a high level. In men a high ligation of the spermatic vessels and division of cord with castration by pulling the testicle through the incision facilitates the performance of a more thorough operation.

If local anaesthesia is used the infiltration is



Fig. 10. C. I. t. l. l. d. m. l. m. p. t. t. t. l. v.
th. m. l. i. r. h. t. m. t. h. g. t. h. l. t. l. v.
m. l. f. h. t. m. t. I. t.

carried out very much as in herniorrhaphy by a 1 per cent solution of novocaine for the skin and 0.4 per cent solution for the deeper tissues.

The femoral nerve on exposure is blocked as high as possible by a 2 per cent solution of novocaine and divided. Beginning as near the bifurcation of the aortic as possible the areolar and lymphoid tissue is stripped down from the vessel and side of the pelvis.

The external iliac artery is now doubly ligated and divided just below the bifurcation of the common iliac and a provisional non-traumatizing clamp placed on the internal iliac artery (Fig. 9). After elevating the leg for a moment the external iliac vein is ligated and then divided (Fig. 10). Apart from a few small collateral branches in the pelvic and gluteal regions the operation should be practically bloodless. From the outer end of the first incision a second incision is carried down to the greater trochanter (Fig. 6). The iliopsoas muscle is now divided fairly high at the greater trochanter and tripped down, exposing the bone until the attachments of Poupert's ligament are divided and the acetabulum entered (Fig. 11). A thin lip is permitted to hang over the edge of the table, articulation is readily produced and the incision continued soon exposing the great sciatic nerve (Fig. 12) which is thoroughly blocked with a 1 per cent novocaine solution and divided as high as can conveniently be done.

From the end of the second incision the skin is divided along or above and parallel with the gluteal fold (Fig. 13) being curved forward when

it reaches a point outside the perineum to join the pubic end of the first incision. The gluteal and other muscle are now divided parallel with and about 1 centimeter above the posterior incision completing the amputation.

According to the degree of involvement (a) none of the innominate bone is removed or (b) the bone is resected or (c) articulated. Resection is very easily carried out by retracting the wound edges and sawing off the lower part of the innominate bone with an ordinary amputating saw (Fig. 16). If disarticulation is to be done the flap should be dissected far enough back to expose the sacroiliac synchondrosis. The symphysis is divided by a knife or the pubis by a saw, the bone rotated outward and the sacroiliac ligaments divided from within outward. This is not difficult.

The divided gluteal, sciatic and pubic vessels are now tied. The stump of the divided iliopsoas muscle is mobilized brought forward and as far as possible united with the edge of the internal oblique and transversalis (Fig. 14). A tube of soft rubber is carried from a stab through the buttock flap into the pelvis and the divided edge of the gluteal muscles and thin covering aponeurosis sutured to the edge of the external oblique reinforcing the abdominal wall. The skin flap is now brought forward and inward and accurately sutured (Fig. 15). Finally a supporting voluminous dressing is applied. The drainage tube is removed in twelve or twenty-four hours.

Ca. t. M. J. l. th. gl. t. d. c. d. y.
m. ta. t. l. g. t. t. f. l. l. t. l. b. d. m.
l. m. p. tat. th. t. f. p. t. m. b. t. th. t.
m. l. f. m. t. O. t. y. D. th. f. m.
d. y. m. t. t.
W. l. m. R. g. s. h. d. h. g. h. t. f. t. d. l. g. d. e. p. l. y.
b. d. h. t. t. y. l. d. d. t. y. c. l. e. s. e. d. b. f.
th. foot. h. l. d. y. b. i. t. a. d. b.
p. f. l. l. t. d. h. h. p. e. t. d. d. p. t.
Th. f. m. f. t. m. t. d. d. p. t. d. m. g. f. m.
th. g. h. t. p. p. l. t. f. f. d. t. b. p. th. o. m. a. t.
Am. p. t. t. f. d. t. p. e. t. o. th. e.
l. g. e. u. l. g. l. l. p. e. f. m. l. th. h.
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d.) th. l. l. d. h. b. l. t. d. m. 9.
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P. t.
C. A. l. d. s. a. m. f. j. p. e. r. i. g. t. f. m. m. l. d.
h. l. t. l. b. d. m. l. m. l. t. t. th. t.

of pelvis. Operative recovery. Death from metastases ten weeks later.

Mary H. age 56 was admitted to the Samaritan Hospital November 28 1915 for advanced carcinoma of the upper third of the right femur which had first been noticed as a small lump near the right groin three months before. The tumor had grown rapidly and involved the back of the thigh and gluteal region. The leg and foot were edematous and the patient very cachectic and emaciated. There was some fullness above Poupart's ligament. The condition caused great pain.

Operation November 9 1915 spinal anaesthesia. Into abdominal amputation as described with resection of right innominate bone as shown in Fig. 16. The removed lymph nodes along iliacs ureter and bladder were enlarged and edematous. The duration of the operation was 5 minutes. Despite her marked asthenia the patient passed through the operation well but remained very cachectic (Figs. 1 and 2) and about six weeks after the amputation bloody serum was purged from the left thorax. The patient died of internal metastases February 12 1916.

CASE 3 Marjolin ulcer with pelvic metastasis. Repeated operations and recurrences. Death from shock.

Pemberton H. age 5 was admitted to the Samaritan Hospital October 6 1915 with a diagnosis of Marjolin's ulcer and inguinal metastasis. Thirteen years before the patient fell down stairs injuring his right foot. This healed after an operation and he was able to walk but two or three years later the leg ulcerated and never healed. About one year ago the ulceration increased and one month ago the leg became very painful and walking was difficult. Recent loss of weight.

Operation (Dr. Steel) October 8 1915. Excision of ulcer and inguinal glands. Prompt recurrence. Operation (Dr. Emich) October 18 1915 amputation above knee recurrence. Operation (Dr. Steele) January 7 1916 excision of carcinomatous ulcer of groin. Prompt recurrence. Foul malignant ulcer. Operation (Dr. Babcock) February 1916. Advanced pelvic involvement. Emaciation and cachexia. Into abdominal amputation and right castration. Disarticulation of right innominate bone and high removal of soft parts. Death followed from shock shortly after the completion of the operation (Figs. 23 and 24).

A NEW METHOD OF TYING A SURGICAL KNOT¹

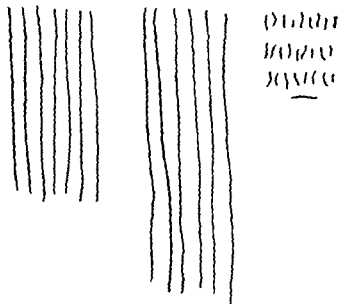
By A. I. GRANT, M.D., Utica, New York

THE history of the method described below of making a rapid and secure surgeon's knot is the outcome of many experiments induced by dissatisfaction with all of the older methods of one hand and two handed ties. The salient features are the use of one very short end the shorter the better and a needle holder or any artery clamp or needle forceps.

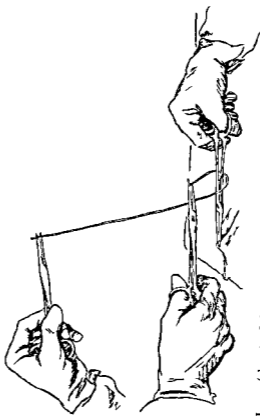
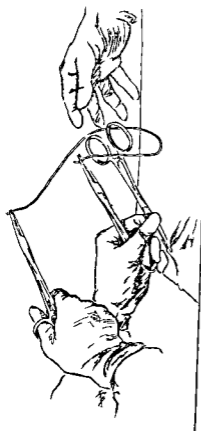
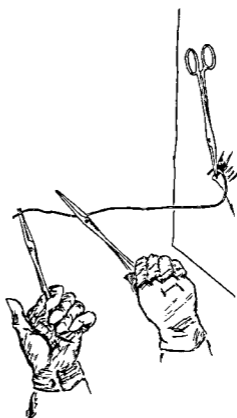
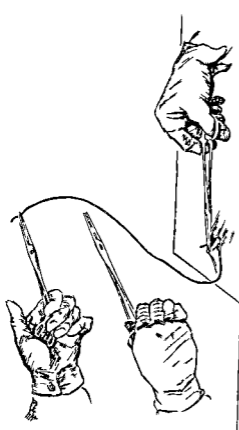
The credit of the idea of using forceps instead of fingers should be given I believe to Dr. A. I. Sorensen of New York now serving with great distinction in the Italian Army. Dr. Sorensen published an article several years ago describing a method of making a knot when the suture had been broken off. Surgeons use forceps in certain cases but I find nothing in the literature describing this method and its universal application.

To tie a clamped blood vessel. A fourteen inch ligature is clamped at its end by a forceps or needle holder held in the right hand. The left end is held by the third fourth and fifth fingers of the left hand or by another forceps. With the thread held by the last three fingers of the left hand or forceps the shaft of the artery clamp is picked up with the thumb and forefinger of the left hand and the right end of the thread is passed from right to left behind the artery clamp so that both ends are on the same side of the clamp. The left side at the moment of passing the ligature the assistant slips thumb and finger through the

openings of the clamp preparatory to unlocking and removing it. The longer left end is pulled upon until the right end is only half an inch from the tip of the artery clamp. The operator now lets go the short end of the thread held with the forceps in his right hand and lays the point across and on top of the thread near and pointing at the



1. The first end of the new tie is one 8 inch catgut strand. (at left) One hand tie 6 knots and waste 6 two hand tie 3 knots and waste 6 new tie 26 knots and waste



I (bo) I ft g h a m t t th l ft th mb d f I g t p b
 ch d h m t t f d t t t T t l ft d d loo;
 F_g 3 H e m t t t f d t t t t
 u d t i f h a m t t l t y
 F_g 4 (b) Sh t l f l g t t l f t d f h a m t a t
 p m t s d a d n l p p o t g p d l f t p
 l g t t p p o t g p d l f t p

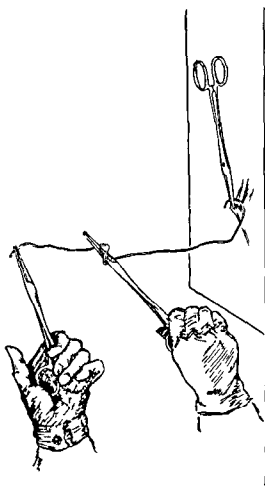


Fig 6 (above) Loop complete! Forceps in right hand starting toward short end

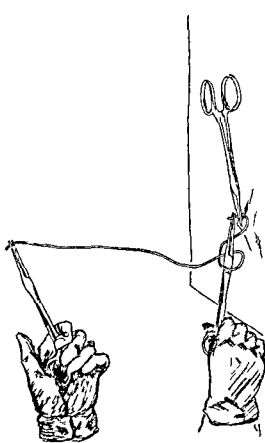


Fig 7 Loop completed. Forceps grasping short end firmly left hand pulling long end over tips of forceps in right hand

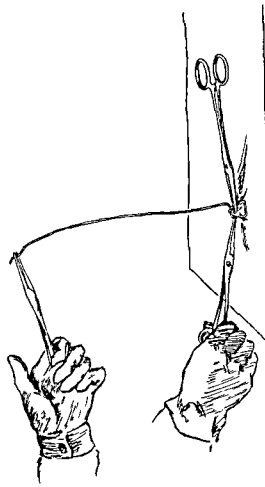


Fig 8 (above) Note contiguity of tips of right hand forceps and hemostat First half of knot completed but too early drawn

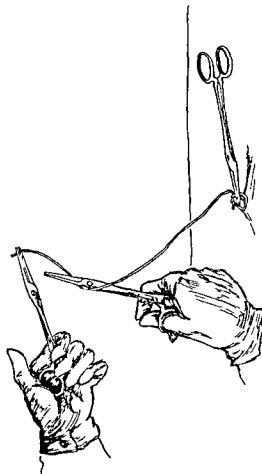
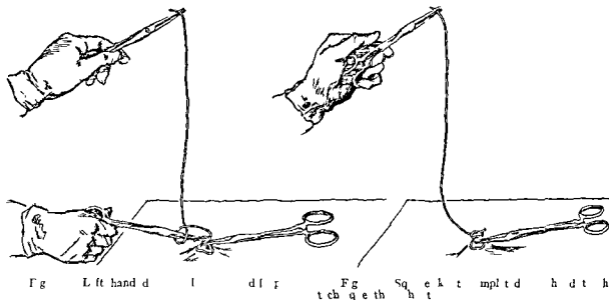


Fig 9 At this hand forceps placed beneath tip pointing up and this loop completes a square knot



left thumb he then carries the point downward and underneath the thread which makes a loop around the forceps and catches the very tip of the short end of the thread and draws it down snugly over the clamped artery as the assistant releases the clamp this makes the first half of the knot. The forceps is then placed beneath the thread pointing toward the left forefinger and is passed upward and then toward the surgeon and then downward and away to pick up the short end and draw the second half of the knot fast.

If a third knot is required for security place the forceps on top of the thread and make another loop which completes another square knot.

The surgeon may easily demonstrate the fact that it is a square knot that he has tied.

When a true surgeon's knot is required the first loop is made by two circles of thread after which the second and third single turns are made as before.

Transfixion and interrupted sutures with needle and needle holder. The only special point in the smooth technique of transfixion and approximation sutures is to sew toward the operator which brings the tension in alignment without crossing hands.

Such interrupted stitches may be placed and tied very rapidly (and are usually better technique than a continuous running suture) obviating the usual custom of laying down the needle holder and tissue forceps and needle before tying the knot and then picking them all up for another suture.

Illustrations. Any dissection forceps artery

clamp or needle holder may be used for the purpose no special type of instrument being necessary for its performance. I have found however that a needle holder of the taper nose variety like Ferguson's or Hegar's is best with all varieties of needles and all kinds of suture material.

Any size of ligature from the largest catgut to the finest silk wire or human hair can be easily handled and visible knots applied in every situation better than can be made by the fingers.

Safety first. The knot is always visible in the making and therefore accurate and secure. Breakage is almost eliminated because necessary tension can be most delicately estimated.

Universal applicability. In any region however small and deep that can be visualized this knot may be accurately tied. In the pelvic vault of the vagina rectum and bladder underneath the liver in the throat and pharynx it may be tied as easily as on the surface.

Time saving. Rapid and accurate transfixion and knotting may be done without laying down needle and needle holder which is an important consideration in dissections requiring many hemostats.

No hand touch technique. There is no doubt as to the superiority of this method when the operator aims at a no hand touch technique for with a Ferguson needle holder and an ordinary needle forceps transfixion sutures may be quickly and accurately placed without hand contact with either sutures or tissues.

Economy. By the use of this method the economy of suture material is almost unbelievable.

By comparison one 28 inch catgut strand as ordinarily cut into three pieces by the instrument nurse for the surgeon who ties with two hands gives three knots. The operator who uses the one hand tie and economizes can get six knots from one strand.

The same skill with the new tie will give 6 to 25 knots with a 28 inch strand. In other words one can tie as many knots with one tube of gut as can be tied with three or four tubes by the older method.

Infection. Serious consideration of the origin of occasional wound suppuration leads to the conclusion that much contact and manipulation of ligatures with the fingers of the nurse and sur-

geon is the greatest source of infection. It may be easily demonstrated that from 75 per cent to 100 per cent of hand contact with ligatures will be eliminated by this method.

CONCLUSION

In general one may say that one half of a surgical operation consists in good exposure and ablation of pathological tissues; the other half consists in hemostasis and coaptation of normal tissues; therefore an ideal knot means that the technique in 50 per cent of all operations will be advanced and refined. I believe this knot will become standard technique with every surgeon who will trouble to verify its multiple advantages.

A MODIFICATION OF THE AHLFELD METHOD FOR DETERMINING THE MATURITY OF THE FÆTUS IN UTERO

By HERBERT THOMS M.D. NEW HAVEN, CONNECTICUT
Att d g Obst G H pl

ONE of the most interesting and at times one of the most trying problems that confront the obstetrician is the determination of the size and maturity of the fœtus *in utero* during the latter weeks of pregnancy. It is a fact that although most men doing obstetrical work realize the importance of careful pelvic measurements yet little or no attention is given to estimating the size of the fœtus *in utero*. Of course it is obvious that it is the adaptability of the fœtus to the bony pelvis that makes normal birth possible. Therefore it often becomes as important for the physician to know something of the size and maturity of the fœtus *in utero* as to have knowledge of the dimensions of the maternal pelvis.

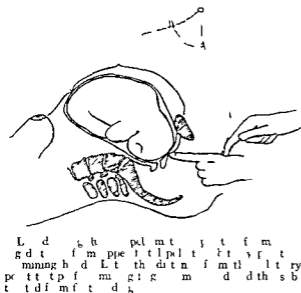
Not only in abnormal conditions associated with pregnancy is the knowledge of the maturity of the fœtus valuable but in the normal patient this knowledge at times becomes most valuable in determining the approximate date of confinement.

In many instances little or no reliance may be placed upon certain facts pertaining to the obstetrical history such as the date of the last menstruation date of quickening etc. as a means of determining the age of the fœtus *in utero*. These events are often forgotten or never taken note of by the patient and calculation based thereupon becomes guesswork.

At present there are three more or less common methods for estimating the maturity of the fœtus and these are known as the Ahlfeld, McDonald and Perret methods respectively. Concerning these it may be said that they are all valuable aids toward securing the information sought but it may likewise be stated that they each possess certain disadvantages which under certain conditions render their use ineffectual.

The first named method appears to be the most valuable. This method is based upon the fact that the fœtus at full term is 50 centimeters in length. It is or should be generally conceded that the length of the fœtus or newborn child rather than the weight is the best index for determining the maturity, a fact recently emphasized by Reed (1).

Ahlfeld (2) pointed out that the true length of the child is twice that of the distance from the vertex to the buttocks of the child in the position normally assumed *in utero*. This he determined by measuring externally with a pelvimeter from the upper border of the symphysis which is supposed to be at the level of the vertex to the uppermost point of the buttocks as palpated and measured through the abdominal wall. Two centimeters are deducted from this finding to allow for the thickness of the abdominal and uterine walls and the result multiplied by two for the final reading.



The obvious disadvantage of the method lies in the fact that in many cases during the latter weeks of pregnancy the vertex enters the birth canal and may be at a level with the pines of the head engaged. To overcome this disadvantage Ahlfeld used in these cases a pelvimeter with excessively curved blades. With the fingers in the vagina against the vertex one tip of the pelvimeter is passed along the fingers until it rests against the vertex through the thickness of the cervix and the reading is made. The disadvantage of this latter procedure are manifest. First a vaginal examination must be made which especially at the time of labor may not be desirable. Second a special instrument is required which must be sterilized at each examination. Third the manipulation of such an instrument in the vagina in the latter weeks of pregnancy must not only increase the likelihood of infection but must be more or less painful to the patient.

In the modification of the Ahlfeld method here to be described all of the above disadvantages are obviated and the method made of much more practical use.

The other methods referred to will be spoken of but briefly. The McDonald method is calculated from the distance measured with a tape from the symphysis to the uppermost point of the fundus uteri following the curve of the abdomen. Without going into detail the objections are first the size of the uterus is influenced not only by the size of the fetus but also by the amount of liquor amni present. Second in the latter weeks of pregnancy owing to variation in the position of

the vertex which may be much below the level of the symphysis the method becomes at once faulty.

The Perret (3) method has to do only with the calculation of the biparietal diameter of the fetal head. In order to employ this method the head must be freely floating above the symphysis and as soon as the vertex enters the birth canal the method is not applicable.

The modification of the Ahlfeld method here proposed may be described as follows. The patient is placed in the lithotomy position for the ordinary vaginal examination. The examination may be conducted either vaginally or rectally. If the head is high up and cannot be reached per rectum the vaginal route becomes necessary. If however the vertex can be palpated at all per rectum the rectal route becomes preferable not only on account of the lessened danger of infection but because the examining finger is in the extension of a line corresponding to the axis of the fetus *in utero*.

For purposes of description and illustration the vaginal route will be described. An examination is made in the usual manner passing the finger or fingers to the cervix. If the vertex (or breech) is in the birth canal it may be easily palpated through the anterior fornix. If the presenting part is too high up slight pressure by an assistant upon the fundus toward the symphysis will bring the presenting part down so that it may be palpated.

With the examining hand in position the finger resting against the fetal head and in a line corresponding with the longitudinal axis of the fetus an assistant measures with a pelvimeter the distance from the uppermost point of the buttocks through the abdominal wall to any easily available point on the examining hand outside the vulva. The index finger of the other hand of the examiner is now placed at this point against the tip of the pelvimeter (see illustration). The reading is made and with the fingertip of the non-examining hand still in position the examining hand is withdrawn from the vagina. The distance from the tip of the examining finger to the point where the pelvimeter rested is now measured. This reading subtracted from the former reading will give the distance from the vertex to the uppermost point of the buttocks after subtracting a small amount for the thickness of the abdominal and uterine walls.

If the examining finger has rested against the fetal head itself through a patent cervical canal it is my custom to deduct 1.5 centimeters before multiplying by two as in the Ahlfeld method. If

however the palpation has been made through the anterior fornix either rectally or vaginally 2 centimeters are deducted Of course further observation may necessitate a change in either or both of these two figures but up to the present time in the cases where measurements have been made before and after birth the results have been gratifying

The employment of the rectal route is obvious and requires no further description In conclusion it may be stated that the modification of the Ahlfeld method here presented possesses the following advantages

- 1 The length of the folded child *in utero* may

be determined with greater accuracy than in external abdominal methods

- 2 The method becomes of wider use no special instruments being required

- 3 The method is a rapid one and conflicts in no way with aseptic technique

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THE EXCISION AND SUTURE OF SUPERFICIAL GUNSHOT WOUNDS UNDER LOCAL ANÆSTHESIA

BY LIEUTENANT SAM BROCK M I C U S A

N o (L k d U S A) G I H p t f

THE advantages of the early excision and suture of superficial gunshot wounds under local anesthesia are first it makes possible many minor operations which ordinarily would not authorize a general anesthesia second it saves dressing material third it prevents the formation of scar tissue fourth it saves time the most potent factor in war surgery

Superficial gunshot wounds may be classified as penetrating perforating and gutter and are caused in the majority of cases by high explosives They are all more or less infected A high explosive bursting into many fragments and traveling at a comparatively lower velocity than the bullet causes ugly gashes tearing and de-vitalizing the tissues and depositing along its course fragments of clothing earth and debris The rifle bullet wound is comparatively clean and usually can be distinguished from the shrapnel wound

Superficial wounds are frequently given little consideration at the Casualty Clearing Stations A hasty dressing dry or moistened in equal is applied or the wound is bipped The patient arrives at a Base Hospital within 24 to 48 hours Many wound show marked infection by this time others with less ample drainage require immediate operation

The most insignificant looking high explosive or shrapnel wound of the penetrating and per-

forating types may cause serious consequences The gutter wound usually takes care of itself The early suture of any gunshot wound which cannot be kept under observation is rarely justifiable Many wounds sutured at the Casualty Clearing Stations require immediate removal of sutures when the patient arrives at the Base Hospital

The possibility of excision and suture of any superficial wound depends on its size and location Those areas where skin flaps are most readily secured facilitating approximation with a minimum degree of tension heal most rapidly

Many wounds can be excised completely intact Such wounds may be closed without fear of subsequent infection Many wounds that have been excised *en masse* at the Casualty Clearing Station have been closed successfully shortly after arrival at the Base

Even when dressed every day the average superficial unsutured wound requires from 3 to 6 weeks to heal The time saved in the healing of these wounds by excision and suture is apparent The dressing material saved is considerable The earlier the wound can be sutured the better After two weeks enough scar tissue has been formed to make excision difficult

The superficial wound shown in the accompanying illustrations were excised and sutured after 4 to 6 day treatment The operations

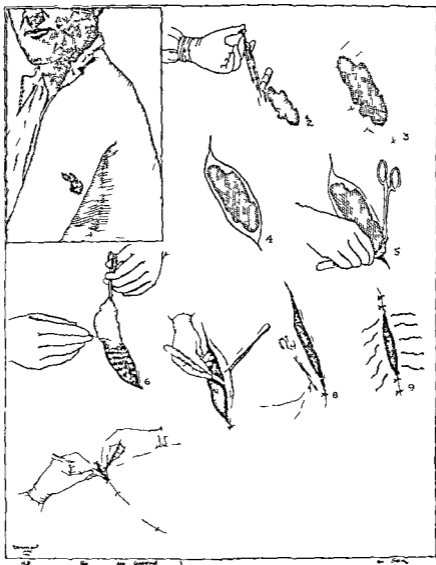




Fig 1 Shrapnel wound after 6 days treatment and 6 days after excision and suture



Fig 2 High explosive wound after 4 days treatment and 4 days after excision and suture

were done in a clean theater where no pus cases were handled. The time for operation was determined by the gross macroscopic appearance of the wounds, no cultures having been made. The patients were not confined to bed, but came to the dressing tent after as well as before operation. It was found, however, that wounds of the arm put at rest with splint and sling made more rapid recovery. Wounds of the face and neck without exception healed by first intention.

Novocaine 1:200 properly infiltrated produces complete anesthesia. An area 5 centimeters in width can be blocked in one line about the wound.

TREATMENT

The infection was controlled by the use of hot dressings and subsequently 65 per cent alcohol dressings. Gauze was boiled in 4 per cent boric solution, wrung out and applied to the wounds. Dressings were changed three times daily. The superficial infected wounds usually cleared up under this treatment in two to three days. Sixty-five per cent alcohol dressings were then substituted and applied twice daily for two to three

days. In many instances where contamination had not progressed to infection, alcohol dressings were employed from the beginning. Whenever feasible, the wounds were exposed to the rays of the sun for an hour daily. When the granulating tissue had assumed a healthy appearance and there was no further discharge, which was usually the case within four to six days, excision and suture was done. Most of the wounds were excised *en masse* by block dissection.



Fig 3 High explosive wound after 5 days treatment and 5 days after excision and suture

Fig 4 High explosive wounds after 6 days treatment and 4 days after excision and suture



Fig 1

lation in the cord from the placental insertion up to the strangulation point was reversed and maintained by the other fetus's heart. The blood crossing the vascular anastomoses in the placenta which constitutes the third circulation observed on its inner face once the amnion is separated. This anastomosis was palpably dilated which would seem to indicate that during the time that the larger fetus survived the other a reversed circulation was present in the cord of the dead fetus which would have become an anastomosis had the circulation in its cord not been completely interrupted. The fetal cord of the larger child presented two parts: one from the placental insertion up to two centimeters from the umbilicus (being a reddish color and of normal thickness) the other, a few centimeters up to the umbilicus, as twisted upon itself so pronouncedly that it must have ultimately produced circulatory interruption and resultant death of the surviving fetus. Perhaps the larger fetus survived thus smaller by 3 or 4 weeks.

The placenta is interesting. It is nearly round, 11 x 2 cm diameter, 5 cm thick and weighs 500 grams, which compared to the combined weight of the twins shows considerable enlargement. The amnion forms a crestlike fold on the large diameter of the placenta. On removal it exposes clearly the anastomosis of the arteries of one cord with those of the other forming thereby an oval upon the placenta (see Fig. 2). Consequently a third circulation is clearly present in this case.

The membranes are complete with a single cavity



11

which encloses the fetus and accommodates within its walls for one centimeter of its length the smaller fetal cord. The rupture is lateral. Without any great difficulty it was possible to separate the chorion from the amnion.

This clearly is an example of monochorial twins and of the extremely rare variety of monoamniotic. The above mentioned amniotic fold was not the remains of an atrophied wall but was a fold arising from a reduction in the volume of the placenta because upon separating the amnion therefrom the continuity of the amniotic membrane is restored without any signs of discontinuity. If the said fold had been the remains of an amniotic wall primitively separating the fetus it would not have been possible to restore the amnion in its continuity as indicated.

The woman was released on the tenth day in healthy condition.

TREATMENT OF CYSTOCELE AND UTERINE PROLAPSE DURING THE CHILDBEARING PERIOD¹

B. THOMAS J. WATKINS, M.D., F.A.C.S., CHICAGO

THE transposition operation, I believe the ideal remedy for cystocele and uterine prolapse after the menopause. This paper will be limited to the treatment of cases that can be relieved by operations which no longer pregnant or labor. Fortunately, only a small percentage of cases of cystocele and uterine prolapse occurring during the reproductive period are so extensive as to require more radical procedures.

Important progress has been made in recent years in plastic vaginal operations for these displacements and much of this work is rapidly becoming standardized. I am pleased to avail myself of this opportunity to commend the work of R. T. Frank upon the anatomy, pathology, and treatment of cystocele and uterine prolapse recently published in *SURGERY GYNECOLOGY AND OBSTETRICS*.

Much of the difficulty encountered consists in adapting the various operations to the needs of individual cases. Cystocele and uterine prolapse are easily repaired, but permanent cures are not so readily obtained. An important requirement is that obtrusion of union not subject to much tension; otherwise the united tissues are certain to stretch and recurrence to take place.

Operation for these displacements are always handicapped as the united surfaces are subjected to more or less tension when the patient is in the erect position; the tissue involved are often congenitally weak and always lacerated, stretched and thinned and are generally subjected to pressure from above by superimposed prolapsed organ.

It is my intention in this paper to describe various operative procedures which can be utilized singly or collectively to the need of individual cases of cystocele and uterine prolapse.

Transverse incision. The transverse incision in front of the cervix should extend freely across the anterior vaginal wall to permit the cervix to tilt easily upward and backward after the operation is done. This lengthens the anterior vaginal wall and allows the body of the uterus to lie properly without undue flexure. The anterior vaginal wall is often congenitally rather weak and retained in the case

of Emmet Skene Baldwin Reynolds and others have emphasized the importance of lengthening the vaginal canal in the repair of these displacements.

Separation of the anterior vaginal wall from the bladder. Blunt dissection with Mayo scissors saves time and lessens bleeding and traumatism if care is taken to find the plane of fascia between the vagina and bladder. The width of the separation varies. It should not be wide enough to endanger the ureters or injure large veins yet should include all redundant mucous membrane and should permit complete separation of the herniated part of the bladder.

Separation of the bladder from the cervix. This is also most satisfactorily done with scissors if caution is taken to find the dividing plane of fascia. The herniated portion of the bladder should now be completely freed from the sac (Fig. 1).

The peritoneum is incised if the cystocele is large if intraperitoneal exploration is desired if the uterus is retrodisplaced or if vaginal fixation of the round ligaments is contemplated.

At this time amputation of the cervix if indicated is done. We believe in amputation in occasional cases of excessive elongation of the cervix only because it endangers labor and stenosis.

Plastic operations upon the broad ligaments. Elastic operation on the broad ligaments is a valuable adjunct to the operation if the uterus is much prolapsed, much increased in size or if the anterior vaginal wall is much shortened.

The anterior colporrhaphy of Emmet the bilateral colporrhaphy of Watkins and Dudley and the Baldwin operation are largely broad ligament operations.

Statistics and other reported results of the Baldwin operation are excellent. In the Baldwin operation the vaginal wall is generously buttonholed to either side of the cervix through which loops of the broad ligament are freely pulled out and firmly fixed by suture anterior to the cervix. The bladder pillars of fascia are also accurately sutured in the median line the entire length of the anterior vaginal wall and a firm posterior colporrhaphy is made. Baldwin has the cervix firmly retracted upward and backward which

the anterior vaginal wall operation is made (Fig. 4)

The plastic operation upon the broad ligaments lengthens the anterior vaginal wall shortens the broad ligaments and thereby elevates the uterus in the pelvis increases the anteversion of the uterus thus lessening intra abdominal pressure decreasing the amount of tension upon the united tissues lessening the tendency of the line of union to stretch and materially insuring a permanent result. Suturing is made of firm tissue securely fixed which is an important feature in plastic vaginal surgery.

Vaginal fixation of the round ligaments The technique is much the same as was formerly employed in the treatment of retropositions of the uterus. It is especially valuable when the prolapse is complicated by backward displacement of the uterus. It is also of great value in cases of extensive prolapse of the uterus. It adds materially to our ability to cure some of the very bad cases without subjecting them to operations to produce sterility.

The round ligaments are not long enough for vaginal fixation without undue tension except when the uterus is retrodisplaced or much prolapsed.

The ligaments should be firmly fixed to the submucous connective tissue by interrupted buried fine linen or silk suture at a place in the vaginal wall that will restore and fix the urethrocele which is almost invariably present to its normal location. The point of fixation will be further considered later.

Advancement of the anterior vaginal wall upon the uterus This consists in changing the place of attachment of the vaginal wall to the uterus to a plane higher on the uterus than formerly occupied as devised by Goffe. The more the vaginal wall is advanced upon the uterus the more certain must be cure of the bladder and uterine displacements. The possible danger consists in complicating pregnancy and labor. As regards pregnancy and labor it is not safe to attach the vagina much higher than the anterior reflexion of the peritoneum.

Excision of aginal flaps Redundant tissue should be excised to an extent consistent with minimum tension upon sutures. The hypertrophied mucosa (skin like tissue) which is generally present over the base of the urethra should be excised otherwise it is liable to protrude later and annoy the patient.

Sutures We believe it advisable to use interrupted buried fine linen or silk for suture of the broad ligaments for suture of loops of the round

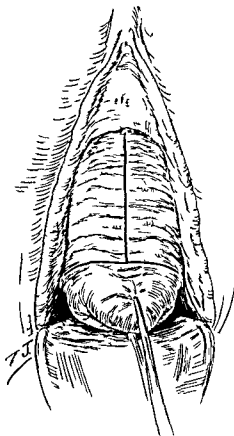


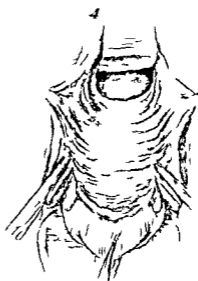
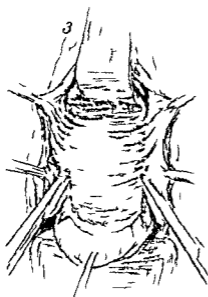
Fig. 1 Illustrates the lines of incisions which are made during the operation.

ligaments and in exceptional cases to use two or three such sutures in the submucous connective tissue. Otherwise Claudius catgut is used entirely interrupted or continuous as seems best adapted to conditions. Some interrupted sutures lessen the danger of retained wound secretion decomposition and febrile disturbances.

Placing of sutures Hemostasis should receive very careful attention before the wound is closed as it determines very largely the character of the convalescence.

The part of the wound caused by excision of the hypertrophied mucosa over the base of the urethra is closed first. The placing of the first circular suture is highly important as it determines the place the urethra will be left in. It closes all or most of the hernial opening of the cystocele and it should insure an anterior position of the uterus. It should include the place in the vaginal wall so that when tied it will restore the urethra to its normal location which is one of relative fixation. (This invariably relieves the partial incontinence of urine which so often results from urethrocele.) The suture should pass

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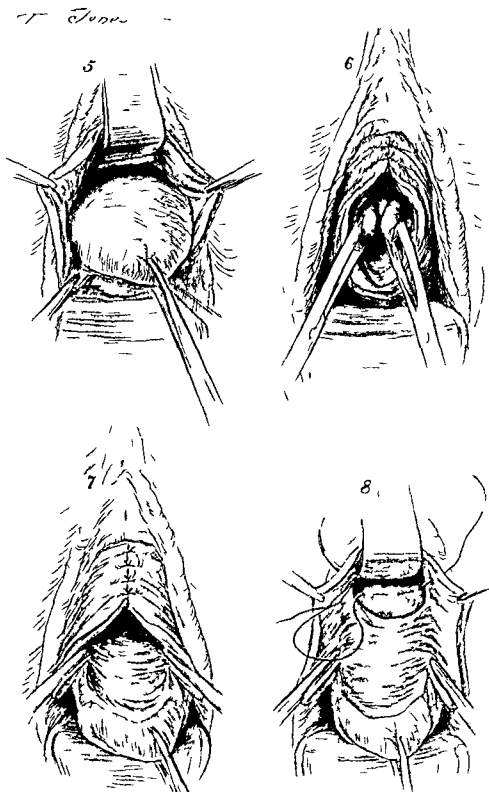
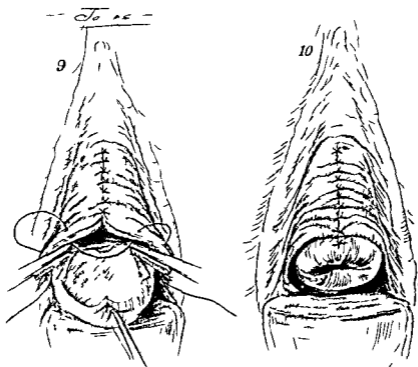


Fig. 3. 5 The body of the uterus has been elevated into the vagina. The fundus is held by bullet forceps. 6 The round ligament has been ligated on either side and a loop of each round ligament appears in the vaginal opening. The hyperthrophied urethra is shown at the base of the urethra to be excised and the opening over the body of urethra closed by suture. 7 The loops of round ligament have been sutured by buried fine linen or silk to the submucous connective tissue and the clitoris is visible. 8 Illustrates the first circular suture which closes the perineal opening, the clitoris is visible to the normal location and kept in position in anterior position.



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through the anterior surface of the uterus at a place above its point of pivotal action when tipped forward or backward so that when tied it keeps the body anteriorly. If placed below such a point it would tend to pull the cervix down and to tilt the body back. When tied care should be taken not to include a knuckle of the bladder. In extensive case this should be a buried linen or silk umbilicus suture. Succeeding sutures should parallel this one at short distances until the wound is closed.

Accurate suture of the umbilicus connective tissue is highly important.

Trachelorrhaphy. Before complete closure of the wound is the most convenient time to make any necessary repairs of the cervix. These may be unilateral or bilateral. Complete amputation of the anterior lip with or without wedge shaped excision of the posterior lip may be required.

Perineorrhaphy. Perineorrhaphy is usually indicated and is necessary to a satisfactory result.

Vesical irritation. The patients almost invariably have a history of more or less bladder

distress. They often neglect to mention it in their history unless questioned especially in regard to it. We have found at Dr. Curtis' suggestion that the vesical disturbance is often the result of incomplete emptying of the bladder. Our present custom is to test this by catheter immediately after urination and to leave a weak solution of silver in the bladder after it is emptied. Catheterization immediately after urination followed by silver nitrate instillation is repeated daily until the emptying power of the bladder becomes normal.

SUMMARY

Wide incision anterior to the cervix, free separation of the herniated part of the bladder, closure of the hernial opening by circular sutures, retraction and fixation of the urethrocele and perineorrhaphy are essential features in the operation.

Amputation of the cervix, trachelorrhaphy, plastic surgery on the broad ligaments and vaginal fixation of the round ligaments are adjuncts which can be utilized as necessary.

TRANSACTIONS OF SOCIETIES

CHICAGO SURGICAL SOCIETY

REGULAR MEETING HELD DECEMBER 1, 1917 WITH THE PRESIDENT DR. CARL BECK
IN THE CHAIR

DEMONSTRATION OF PATIENTS

DR. CARL BECK showed a case of amputation of the shoulder girdle and discussed the possibilities of plastic operations to fit an artificial stump. He also showed a case of plastic operation on nose and ear.

TRANSPLANTATION OF FASCIA FOR LYMPH STASIS

DR. JOHN F. GOLDEN discussed the transplantation of fascia for lymph stasis.

DISCUSSION

DR. E. WALLIS ANDREWS: The operation of Handley or modifications of it do not give so favorable results in my experience as those of the Kondoleon operation. With the latter I have had 50 per cent successful results and 50 per cent partial failures. Kondoleon is a Greek surgeon. The technique of the Kondoleon operation I demonstrated at the Clinical Congress in October. Perhaps some of the men present saw that demonstration at Michael Reese Hospital.

This method consists in making long incisions and free dissections of sections of fascial covering or aponeurosis covering the muscles. One can cut through the whole thickness of the superficial fascia and then cut from one extremity to the other of the long axis of the limb ribbon of muscle or fascia.

In some cases the results are brilliant from this operation while in others they have not been so good. In a case of elephantiasis I operated on this fall; the results were not perfect but the patient improved 25 per cent. Dr. Lisendrath had operated on the same patient at his clinic by the Kondoleon method and his results were somewhat similar but later the patient had a relapse.

DR. DANIEL N. LISENDRATH: This patient concerning whom Dr. Andrews speaks had an enormous lymphoedema. At the end of a year there was a large growth. When I re-examined her I found the limb had decreased in circumference about five or six inches. One can hardly conceive of the former size of this woman's limb; it was 18 or 20 inches in circumference. The thickening of the deep fascia prevents any communication between the superficial and deep lymph vessel and the idea of

Kondoleon and the idea carried out by Dr. Golden is to establish some sort of collateral circulation so that the deep lymphatics will take up the work of the superficial. I followed Kondoleon's technique in every detail. I took out a section of the fascia of the thigh as large as the outstretched hand. I rolled it up into a strand into the portion we had excised and then stitched it into the deep muscles and did the same with the leg proper.

The trouble with these cases is this: for a year and a half as long as there is a possibility of communication between the deep and superficial lymphatics improvement takes place but as soon as the fascia begins to contract down upon the transplant the result is practically the same as Dr. Andrews described. Dr. Andrews operated on the same woman two years later at which time her condition was as bad as when I started.

HEPATITIS AS A CONSTANT ACCOMPANIMENT OF CHOLECYSTITIS

DR. EVARTS GRAHAM read a paper entitled "Hepatitis as a Constant Accompaniment of Cholecystitis" with lantern slide demonstration. (See p. 521.)

DISCUSSION

DR. COLFMAN G. BUFORD: I sincerely appreciate the points concerning the bacteriology and the long duration in which bacteria are present in the bile as referred to by Dr. Graham because I have been rather distressed about the frequency of papers in the last few years concerning the frequent return of gall stones in the experience of some surgeons and the need of secondary cholecystectomies. I have felt that very much unnecessary work was being done in connection with both primary and secondary cholecystectomy. During the nearly four years that I was associated with Dr. Fenger I do not recall that we had to do a cholecystectomy on account of recurrence of stones and I recall only one secondary cholecystectomy among the private patients for stenosis of the cystic duct following the removal of stones. That is quite parallel with my own experience. I have tried to reason out why these men are having so many recurrences of gall stones and why is it so many surgeons are taking out so many gall bladders even at the primary

tion and so on. When we reach the condition of well marked cirrhotic change of definite firm hard liver we see a large liver lobule entirely destroyed and substituted for it well marked connective tissue around the lobule.

In regard to the length of time in which bacteria may come out of the liver I intended to mention but possibly I forgot it that the observation which Terrier made in 1894 was to the effect that bacteria may be found coming out of the drainage tube for months after the establishment of a fistula in one case four months after the establishment of a biliary fistula he remembered getting colon bacilli in large numbers.

HÆMORRHAGE SECONDARY TO NEPHROLITHOTOMY

DR JACOB FRANK read a paper entitled Hæmorrhage Secondary to Nephrolithotomy (See p 538)

DISCUSSION

DR JOHN A WOLFE In speaking of hæmorrhage following nephrotomy about two years ago at the Cook County Hospital Dr Kanavel removed a stone by sectioning the kidney in which there was considerable infection. About 10 days later the man started to bleed violently from the wound and passed bright red blood from the ureter into the bladder. He urinated almost bright red blood and rapidly became exsanguinated. In six or eight hours the red blood count dropped down very materially and the hæmoglobin to thirty. We transfused the patient by the citrate method hoping to build up the red count again sufficiently to be able to do a nephrectomy. He stopped bleeding at once and has not bled since and he still has his kidney.

DR L. L. McARTHUR Hæmorrhage from the kidney not infrequently results from a blow on the kidney. The hæmorrhage is apt to continue and require surgical interference. The mere opening down to the kidney and draining the pelvis of the kidney will stop the hæmorrhage. It does not require extirpation of the kidney to stop the hæmorrhage. I have several times checked hæmorrhage from the kidney by adopting such a method.

DR FRANK (closing) I thoroughly understand that a slight hæmorrhage from the kidney will stop but when a patient is dying you must do something more than rely on bathing the parts with the salts of the urine. About thirty years ago I did a section of a kidney shortly after which the patient began to bleed and before I could reach him he was dead. I remember another case of trauma of the kidney in a little girl who had fallen on a sidewalk causing a rupture of the kidney. A large perirenal hæmatoma formed. I operated on her and thought she was going to get well when suddenly more than a week afterward she began to bleed and before I could get to her she was dead. I am sure the patient whose case I have just related would not have died if I had performed pyelotomy thereby preventing back

pressure. Where urine is put up in the kidney or tissues it will cause infection unless it has an outlet.

In the case I have reported I made a clean cut and sewed it up so as to afford the best possible advantage for primary union to take place. There was not as much blood in the urine as after an ordinary pyelotomy. After a nephrotomy we naturally would expect a large flow of blood into the bladder. When the entire ureter is blocked with blood what happens? The secreted urine of the kidney involved has no outlet and it must back up. It must overwhelm the kidney. The tissues become soaked and edematous and if it remains for a few days the secretion will become putrid and infect the kidney. The secretion of the kidney must have an outlet. If the urine cannot get through the ureter it prevents union of the tissues. Hæmorrhage occurs.

The removal of calculi from within the parenchyma via a total nephrotomy is much more of a risk than the removal of stones embedded in the extreme upper part of the pelvis. I have here ten stones which I took out of the parenchyma of the kidney. You must understand that it required a great deal of manipulation to do that and if primary union was not obtained we would have profuse hæmorrhage naturally. These are the cases I have reference to that require in addition to the nephrotomy a pyelotomy. I have had three similar cases since that made uninterrupted recoveries by the method I have just described.

THE ENTRANCE OF AIR INTO THE MEDIASTINUM DURING OPERATIONS ON THE NECK

DR COLEMAN G. BUFORD read a paper entitled The Entrance of Air into the Mediastinum During Operations on the Neck (See p 540)

DISCUSSION

DR SAMUEL C. PLUMMER I have not had experience with any case where symptoms were caused by air being drawn down into the mediastinum during inspiration. I am however familiar with the fact that air is drawn in there in operations low down on the neck especially the operation for the removal of tubercular glands where we follow down behind the clavicle into the angle between the internal jugular and subclavian vein. This sound of air being drawn in is startling because it suggests an opening of one of the veins and air embolism. My practice is to plug up immediately this space with a piece of gauze which stops further inspiration of air and also relieves the noise which is so disconcerting. When the air is under pressure it leads to the symptoms. Dr Buford speaks of it as rational treatment to see that there is an opening there through which the air can escape.

In writing on two cases of injuries of the thoracic duct which occurred while I was assisting Dr Fenger in connection with the removal of tubercular glands of the neck I called attention to the aspiration of air which made this startling noise and after

I submitted my manuscript to Dr. Fenger. He suggested that I add to it that sometimes air is drawn down into the mediastinum and around the heart and can be detected on auscultation by cephalic sound both in the peritum and with the heart's action. He did not, however, speak of any serious result from that and possibly up to that time he may not have heard any. It was more a matter of scientific interest than of any clinical significance as coming the way he presented it at that time.

Dr. DAVID C. STRAUS. In connection with Dr. Buford's paper I should like to mention a case which I think of interest. The patient, M. H. Michael, 33 years of age, brought to the hospital at 530 p.m. Dismembered with the typical history and symptoms of acute appendicitis and was admitted to the surgical service as a case for removal of the appendix.

The patient was a girl. He had never had a malarial attack. He had a negative roentgen discharge cough. He had a dry pneumonia.

There did not seem to be anything about the cretaceous lithogenesis. He had a typical pleural effusion. The marked distention of the right side of the abdomen and the abdominal tenderness in the right lower quadrant and there was no tenderness in the umbilical point. The white blood count was 100.

I examined the chest carefully. I regularly looked for the causes to prevent a possible pleural effusion. I began a pleural effusion. The lungs were clear. The central venous pressure was normal before the operation.

I performed an appendectomy. The usual method and the operation was not particularly difficult. I completed the operation without complication. The patient had the anesthesia locally. He was not coughed and I could not do anything before the final operation. During the operation he had no difficulty breathing but not much. This was often observed.

At the time of the operation he was apyrexial and was able to feed himself in the afternoon. He left the table good condition though he remained in the recovery room. The record shows that on his return to bed at 4:40 p.m. he had a small amount of blood in his sputum but he had no other symptoms. He was discharged at 5 p.m.

By midnight the patient had come down to 104 and he remained at 104 per minute but they were still below. By 3 a.m. the patient was at 104 and had seen again at 4 and 5 p.m. and the patient coughed occasionally. His difficulty in breathing increased at 7 a.m. he suddenly developed a respiratory attack of dyspnea. He had no labor at the time and he was 6 p.m. in the afternoon. The patient was not in the afternoon.

Cyanotic lips, ears and extremities were absolutely blue and his entire face was dusky. He was struggling for air or rather struggling to expel the air he had in his chest as expirations were greatly prolonged and inspirations were merely short gasps. He was given a hypodermic injection of morphine sulphate 1 grain with opium sulphate 1 grain. Following this hypodermic medication the condition seemed to be somewhat relieved. On examining his chest I found that the entire left lung was markedly emphysematous, the cardiac dullness being completely obliterated by percussion giving a hyperresonant note over the entire left side of his chest. The right lung showed normal findings on percussion. The whole chest was filled with heezing sounds accompanying expiration as well as numerous moist bubbling rales. The expiration was loud and prolonged but not of the tubular type. The abdomen was negative as not tympanic and was not distended. There was but little sputum and this did not contain blood. There was nothing to suggest pulmonary embolism. The condition seemed to be due to acute interstitial emphysema of the left lung.

At the patient's condition was not so desperate as there seemed no indication to do anything but watch him carefully.

That afternoon, December 22, subcutaneous emphysema was plainly to be made out just above the manubrium sterni in the suprasternal fossa and on both sides of his trachea in the neck. There was also some in both supraclavicular fossae but more on the left side than on the right. On palpation of the skin in the areas gave the typical crackling sensation that is characteristic. It was no accident that the patient was suffering from mediastinal emphysema. During the strangling while going under the anæsthetic there probably had resulted a rupture in one of the passages in the left lung probably in one of the smaller bronchioles. The emphysema had filtered through the interstitial tissue of this lung and being held within the lung by the interlobular pleura so that it could not escape into the pleural cavity. For a pneumothorax it could only escape toward the hilus and follow the larger bronchi and the vessels had escaped into the mediastinum and up and into the subcutaneous tissue of the neck. The sudden suffocative attack in the morning had probably been caused by pressure upon or displacement of the larger vessels and heart by the emphysema.

I considered the possible necessity of and as prepared to carry out the procedure suggested and used the success in case by Tegel. This consists in making a transverse incision in the jugulum and applying a Bier's suction cup and a patting the air from the mediastinum. But his condition gradually improved and this did not seem indicated though he was still quite cyanotic.

The cyanosis did not entirely disappear until January 6, 1916. On December 9 I had a roentgenogram taken of his chest. These did not dis-

close any pathological condition to account for the development of the interstitial emphysema. Apparently the condition had been caused by severe straining at the time the anæsthetic was being administered.

The patient made an otherwise uneventful recovery and was discharged on January 9, 1916, cured.

DR E. C. RIEBEL: I wish to speak in confirmation of this mediastinal disturbance by saying that we have a similar condition in pneumothorax. It has been claimed by a number of experimenters that the entire symptom complex of pneumothorax is due to a displacement of the mediastinum, but inasmuch as venesection in Dr. Buford's case was accompanied by prompt relief, it still more confirms that idea, because evidently the vessels at the base of the heart were kinked and as there was relief of the venous congestion the vessels straightened out. The reason that symptoms do not occur with regularity is due to the variable structure of the mediastinum in various individuals. We know that we can open the chest cavity in one patient with perfect impunity and have no symptom complex follow. In another patient it will be followed by an extremely stormy symptom complex and those differences are undoubtedly due to the various degrees of rigidity of the mediastinum permitting either slight or marked displacement.

In regard to the wounds of the lung and emphysema, I had an experience of that type several years ago and in that condition we are dealing with tension pneumothorax which forces air from the parietal pleura along the way into the mediastinum and the best way of treating such cases is by the method of Bramann, who resorted to a small thoracotomy, inserted a tube sewed it tightly and tied to the tube a very thin rubber glove finger or something of that kind which permits at each expiration the air to escape. The glove finger falls over as soon as

inspiration ceases and when expiration occurs the opening is closed. Thus the air is pumped out during inspiration and none can enter during expiration.

DR CARL BECK: In 1916 Boehler, a surgeon engaged in war surgery abroad, published a paper entitled "Gunshot Wounds of the Larynx." This appeared in *SURGERY, GYNECOLOGY AND OBSTETRICS* of September 1915. In his paper the author referred to conditions similar to those mentioned by Dr. Buford. This surgeon, who had had a large experience in war injuries, observed that a great many soldiers with gunshot wounds died so suddenly from emphysema of the head, neck and chest that the head became like a blue rubber ball. Post-mortem examinations on these cases revealed an emphysema which extended over the neck and head. He advised the soldiers that should any such thing develop to use a bayonet for the time being and send the wounded man to the hospital. He saved the lives of many men in this way by afterward treating them in a hospital.

DR BUFORD (closing): As this subject has come before me, it has interested me more than the most of you, but I am certain that if you ever saw this clinical picture you would become interested in it also. These patients hold their breath for a long time and their jaws are more rigid than in any condition I am familiar with and one must struggle to release the jaw to do artificial respiration. Artificial respiration does help some. I do not believe there is much promised through incising the skin in mediastinal emphysema in the acute cases. I do not believe they will get relief through high punctures or opening the original wound. I am certain more air would be drawn in. If anything is done the anterior mediastinum must be punctured and I still doubt whether puncture is of much value. As to whether there would be suction when we open in front of the mediastinum, I do not know.

CHICAGO GYNECOLOGICAL SOCIETY

REGULAR MEETING HELD NOVEMBER 16, 1917, WITH THE PRESIDENT
DR N. SPROAT HEANEY IN THE CHAIR

DR ARTHUR H. CURTIS reported two cases: 1. Interstitial pregnancy. 2. Adenomyoma of the recto-vaginal septum. (See p. 551.)

REPORTS OF CASES AND EXHIBITION OF SPECIMENS

DR BERTHA VAN HOOSEN: This specimen was removed from a woman who had practically a double uterus, although one of the uteri is miniature. The patient has been married for ten years and has had eight pregnancies. Three of the children

were delivered at full term and five were aborted at two, three, five, one and seven months respectively. The patient had been complaining for the past two years of a great deal of backache and abdominal pain. She had a retroversion of the uterus. In order to relieve her symptoms and as she desired to become sterile, this specimen was removed. One round ligament came off from the tiny half of the uterus, while the other round ligament came off from the other side. You will notice the cervix was partly removed.

The second specimen I want you to see because I believe no one is in the habit of removing the entire

cervix far lo to the vaginal mucosa and taking a small piece of the uterine wall for a biopsy. There were a number of small fibroids connected with this.

The third specimen was removed in the same way so as to leave all the blood vessels intact. This is a fibroid uterus that is pregnant between three and four months. The patient had had a miscarriage three weeks. She had been pregnant seven times with this child and delivered at full term. There were many fibroids at the junction near the cervix that seemed to come from the whole uterus. It looks as though it might have been a cause of placental previa.

RUPTURED TUBAL PREGNANCY

Dr J. F. L. BAER. I have a colored woman, 35 years of age, who has been married for 10 years and has never menstruated. During the two years of her married life she began to have monthly menstruation, but as though they were going to sell, and that was all she noticed. She was able to have intercourse without any discomfort. Examination revealed a vagina normally wide at the introitus and but the ovaries deep. It terminated abruptly and suddenly. Beyond that, generally there is nothing to be felt. With combined recto-anal and abdominal examination at about three centimeters above the termination of the vagina, the uterus was felt to be of a uterus in the shape of a very small transverse placed in the middle of a round mass, a fine lead pencil, about a centimeter across. In connection with this, there is a small left-sided ovary, and the other, running to the right side and blindly to the pelvic wall. While this anomaly in itself is exceedingly rare, still it occurs, but the thing of interest to me is that during the two years of her married life she claimed to have monthly menstruation, and when I saw her, she had a skin they had stunted, reddish pink. Chemically, the presence of blood (hematin) was found.

Dr H. F. BAER. What is the condition of the ovary?

Dr BAER. It is cystic.

Dr H. F. BAER. What about the hemorrhage?

Dr BAER. I think the hemorrhage was free to the abdominal cavity.

RUPTURE OF THE UTERUS

Dr N. S. SPROAT. I have a case of rupture of the uterus, which occurred from a fall on the abdomen.

A young woman, 25 years of age, and the mother of a child, fell at 6 o'clock in the morning. After a severe pain in the head, she fell on the floor. About 10 o'clock, the physician applied for a cesarean section. In an hour and a half, the physician performed a cesarean section, and the child was born. The mother was in good condition. The child was born at 3 o'clock, and the physician examined the patient and found the placenta in the uterus.

The patient then referred to the physician as a case of ectopic pregnancy. The physician made a diagnosis of rupture of the uterus. At 5 o'clock, the patient died, and the physician performed a cesarean section. The child was born at 3 o'clock, and the physician examined the patient and found the placenta in the uterus. The patient was in good condition. The child was born at 3 o'clock, and the physician examined the patient and found the placenta in the uterus. The patient was in good condition. The child was born at 3 o'clock, and the physician examined the patient and found the placenta in the uterus.

also abdominal drains. The blood filling the peritoneal cavity showed evidence of infection was muddy in color and with a bad odor. The tissue around the rupture was covered with a dark grayish deposit. The patient lost a very little blood and returned to her bed in very good condition. Her maternal temperature was 102 on the second day and on the fifth day her maternal temperature was 100 and her pulse 80. She however died on the tenth day from general peritonitis.

VICARIOUS MENSTRUATION

Dr JOSEPH L. BAER. I should like to hear a expression of opinion regarding a case I have under observation now. The patient presented herself at the dispensary two weeks ago with the following history: She is 25 years of age, has been married two years and has never menstruated. During the two years of her married life she began to have monthly menstruation, but as though they were going to sell, and that was all she noticed. She was able to have intercourse without any discomfort. Examination revealed a vagina normally wide at the introitus and but the ovaries deep. It terminated abruptly and suddenly. Beyond that, generally there is nothing to be felt. With combined recto-anal and abdominal examination at about three centimeters above the termination of the vagina, the uterus was felt to be of a uterus in the shape of a very small transverse placed in the middle of a round mass, a fine lead pencil, about a centimeter across. In connection with this, there is a small left-sided ovary, and the other, running to the right side and blindly to the pelvic wall. While this anomaly in itself is exceedingly rare, still it occurs, but the thing of interest to me is that during the two years of her married life she claimed to have monthly menstruation, and when I saw her, she had a skin they had stunted, reddish pink. Chemically, the presence of blood (hematin) was found.

She has all the normal characteristics of a female. She has no breasts, she has female pelvic measurements, but the thing that interested me particularly was the question of vicarious menstruation and I would like to know if you have seen similar cases.

Dr EMIL RIES. I have never seen a case of vicarious menstruation and I have never seen one demonstrated by any one of the methods to be used in menstruation when examined properly.

Dr BAER. I should like to know if you have seen every possible argument against this case so as to be absolutely sure it is a case of true vicarious menstruation. I would like to have that blood put under the microscope and see if it is really human blood.

Dr BAER. We have shaved the ovaries and found no blood added to the denudation of the skin. The patient is a healthy, robust, and a healthy laborer and the presence of hematin in the

reported The underwear was seen by half a dozen men at the time the patient was examined in the hospital and there is no doubt about the color of it She is to be admitted to the Michael Reese Hospital for controlled observation

DR RIES Hematin does not prove that it was human blood that was in her avilla Unless human blood corpuscles are shown coming out of the skin of her avilla I should suspect the case to be a factitious one

FETAL DEATH DURING LABOR

DR CHARLES B REED read a paper entitled Fœtal Death During Labor (See p 545)

DISCUSSION

DR CHARLES E PADDOCK I can add little to Dr Reed's remarks as he has so completely covered the subject Asphyxia of the newborn is entirely too frequent and may be put down as one of the preventable accidents of childbirth Carelessness on the part of the accoucheur and the haphazard way in which so many of the obstetrical cases are conducted and a want of appreciation of the condition of the fetus *in utero* during delivery account for many asphyxiated newborn

Most of the deliveries are made in homes and attended carelessly and any sudden change in the condition of the baby goes unnoticed The baby is born dead the cause unknown The physician is blamed by the family and not unjustly in the majority of cases

I believe a tight cord around the neck of the child in the second stage of labor is one of the most usual causes of asphyxia An observing physician would have detected the condition by frequent auscultation of the fetal heart and have applied forceps Because of a want of assistance at a case conducted at home the physician often delays in interfering with labor or applying forceps until it is too late to save the child In hospital practice the fetal mortality is much lower than at the homes This is natural because of the facilities for giving the woman in labor better attention with internes constantly watching the fetal heart tones and all conditions present to terminate the case at a moment's notice

As I look back I am convinced that many cases of latent asphyxia were due to thymus enlargement instead of causes attributed as meningeal heart disease etc The number of such cases which have been revealed by acute observation is surprising and the results of X ray therapy were most gratifying

After an experience extending over a good many years mainly devoted to an obstetrical practice I have tried all forms of anesthesia and am convinced that ether chloroform nitrous oxide all have their place in obstetric anesthesia For a great many years chloroform or the A.C.I. mixture was the favorite and I have yet to see a mother or child injured in any way by their use Because of the unfavorable reports chloroform was abandoned and ether used but the result was not satisfactory The

rapidity of its action and the rapidity of its disappearance are the qualifications necessary in an anæsthetic in obstetrical work This we have in chloroform which we have not in ether Ether should be reserved for obstetrical operation Nitrous oxide is used in hospital obstetrical practice It must be given by an expert It is not the ideal anæsthetic for the delivery of the head

During the first stage of labor chloral hydrate may be given and is very useful in quieting an irritable uterus in a very nervous patient It has no bad effect upon either mother or child I am not an advocate of the use of scopolamine morphine as a routine practice I have seen its bad effects upon the child and I have also witnessed the flushed contorted features of the patient with her maniacal symptoms The labor is usually prolonged and forceps are indicated Postpartum hemorrhage is more frequent Notwithstanding reports to the contrary I am convinced that copolamine and morphine as generally used is a pernicious analgesia We are saving the patient a little temporary suffering at the risk of the child It undoubtedly has its place in obstetric analgesia but only in well selected cases

Regarding the use of pituitrin I certainly agree with what the essayist has said I do not know of any agent that has come to us in the past few years which has been such a life saver as pituitrin when used properly On the other hand it has done a lot of harm and much of this harm comes from the reports that have gone out in the magazines and reports from the proprietary houses regarding the use of it in labor But pituitrin used as Dr Reed uses it or as any other member of this society would use it has done a lot of good

DR CHARLES S BACON I do not see how we can determine the cause of fetal deaths with any certainty until we get more postmortem examinations of stillborn children While we do not know whether there are intracranial hemorrhages or not it is difficult to say what is the cause of death and as Dr Reed has said many of the hemorrhages which we find with a simple examination may be due to injuries that occur at the time of death but are not really the cause of death I do not know how many deaths occur in the last part of labor before the rupture of the membranes I have an idea that deaths are very often due to disturbance of the placenta or maternal circulation It may occur at any time and the emphasis given to the pressure of the head of the child or the body of the child may possibly be exaggerated It is a common experience to find this history that the fetal heart tones have failed and the intra uterine death was preceded by a period perhaps not very long of tetanic contractions of the uterus In those cases there is no question but what anesthesia or analgesia produced by morphine may be a preventive measure if the child is saved by the use of an analgesic That is the chief point I wish to make

DR C HENRY DAVIS Is it well in many cases to wait until the fetal heart tones are definitely bad

before applying force. In the case in which the patient is in a position to be able to perform the operation without definite progress, I think something should be done to ward terminating labor. In the second place I wish to emphasize the necessity of microperforation of the fetal membranes. The uterine contractions are more upon the basis of the stillborn or the dead than the first week subsequent to birth. This will often explain the cause of death when the microperforation is made. In the third place I think that Dr. Reed has done well in calling our attention to the danger of uterine perforation. Here the patient is in a position to be able to perform the operation in increments of a few minutes and may be the entire cause of fetal death. At the Lying-in Hospital have almost lost the entire patient in the third stage of labor. We do not use more than two or three times a hundred deliveries before the third stage of labor.

So far as anesthetic narcosis is concerned there is no satisfactory result. I think that the proper use of an anesthetic agent is a danger to the mother or to the baby. I have had painful labor. When it comes to the third stage of labor, anesthetic ether and chloroform because of their close affinity with the uterus are not quickly eliminated as narcotics and the effect will affect the baby to a great extent.

In the use of forceps I would like to call attention to the type of blade. I doubt if the Tarnier type is in true contact with the cephalic curve. I think the danger is so great if applied than the Simpson type. I think the danger is so great if applied than the Simpson type. I think the danger is so great if applied than the Simpson type.

PROBLEMS ENCOUNTERED IN ABDOMINAL OPERATIONS

DR. THOMAS J. WATKINS outlined some problems encountered in abdominal operations (see p. 54).

DISCUSSION

DR. RICHARD R. SMITH (and R. J. Mich. G. N. I. H. A. B. C. Y. M. U. H. N. T. D. Dr. W. H. N. P. P. R. M. A. N. Y. I. N. G. T. H. A. S. P. K. E. T. U. R. C. L. E. S. H. A. V. F. O. L. L. O. W. E. D. U. T.)

In reference to the anesthetic, he has used all the usual anesthetic agents. He has used all the usual anesthetic agents. He has used all the usual anesthetic agents. He has used all the usual anesthetic agents. He has used all the usual anesthetic agents.

In carrying out the anesthetic, the patient should be in a position to be able to perform the operation without definite progress. I think something should be done to ward terminating labor. In the second place I wish to emphasize the necessity of microperforation of the fetal membranes. The uterine contractions are more upon the basis of the stillborn or the dead than the first week subsequent to birth. This will often explain the cause of death when the microperforation is made. In the third place I think that Dr. Reed has done well in calling our attention to the danger of uterine perforation. Here the patient is in a position to be able to perform the operation in increments of a few minutes and may be the entire cause of fetal death. At the Lying-in Hospital have almost lost the entire patient in the third stage of labor. We do not use more than two or three times a hundred deliveries before the third stage of labor.

make a study of aesthetics. He is an older man. He knows the literature of the subject and follows the very latest therefore he is able to administer the various anesthetic well and we have found it of the greatest possible advantage.

In reference to the rubber dam, we have been employing it for years. It is the greatest advantage and we have found as Dr. Watkins has that a heavier rubber pack is advantageous because it is the additional bulk is wanted.

We have never lost the cervix. I have not thought it necessary. We approximate the ligaments in the manner spoken of by Dr. Watkins and although we have not examined every case of uterine perforation, in those examined we have found few cases in which the cervix has perforated.

I would like to go into the discussion of the indication for the use of the tubes. When the tubes are removed, it is to save a subject and it is liable to become confused in considering it. Generally speaking, however, with a large percentage of operations, however, in the pelvis, the matter of function should be first in our minds. The first question which should be answered as to the operation to be chosen is: Does this woman need her uterus? her tube? her ovaries and how far may we consistently and safely go in the preparation and maintain her health? I agree fully with Dr. Watkins' statement to emphasize the uterus, but occasionally happens in a young woman, especially a young unmarried woman, that she likes to feel she is menstruating that is like other women although she cannot be rendered. This should be carefully discussed with the patient before an operation is done.

The answer to the question is: Yes, the women feel about it, but I think it is very essential to have a clear understanding with the patient before doing anything.

DR. N. SPROAT HEANEY. Dr. Watkins has presented a subject of very much importance. Dr. Watkins called attention to one or two points in the lecture which I would like to discuss. He gives us a datum that the uterus should be removed when the tubes are taken out. Dr. Watkins no doubt had special cases in mind when he said this, especially cases of tubercular infection of the pelvis. In such cases, when the tubercular infection is established, a definite tubercular infection is present. In such cases, when the tubercular infection is present, a definite tubercular infection is present.

For instance, the uterus may be a small or a large bilate hydro-salpinx with the uterus entirely normal. In such a case, Dr. Watkins also would no doubt remove only the tube and would leave the uterus and both ovaries. But the ovaries are entirely normal.

Whether men trust on is sentiment or not or whether it is a process which is necessary in order that a woman may feel perfectly well is one question.

tion and whether a patient considers that she is invalided by not being able to menstruate is another question. So long as so many women are convinced that it is necessary for them to menstruate if they are to remain well we must be very slow in precipitating amenorrhœa. I myself believe that the laity and the profession lay too much stress upon this matter but as long as patients are made nervous by the idea I think we should give their opinions some consideration when their opinion is so necessary to their health.

I also do not believe that the uterus is necessary for the maintenance of normal ovaries but believe that the difficulties which ovaries meet after the removal of the uterus is largely due to a disturbance in the blood supply occasioned by the removal of the uterus. As ordinarily performed a hysterectomy ties off the uterine and anastomosing uterine arteries and veins so that a severe disturbance in the blood supply to the ovaries results. I have found markedly enlarged ovaries in several cases a few weeks after hysterectomy when at the time of operation the ovaries had been normal. Usually these ovaries returned gradually to a normal size but they did not always do so. Sometimes they reach the size of an orange and necessitate removal the same as any other ovarian swelling of similar size may necessitate operation. However in cases where the triangular resection of the uterus has been performed instead of an hysterectomy I have never seen any change in the ovaries occur and this fact I attribute to the undisturbed blood supply of the ovaries in this operation.

Dr CURTIS's suggestion to use a rubber pack in obstetrics in lieu of a bag or gauze packs is a good one and I believe is worthy of trial. We however should not later forget that Dr Curtis originally suggested its use.

DR WILLIAM C. DANFORTH. As to the question of leaving free blood in the abdominal cavity in the last few years I have been leaving it as Dr Watkins has said removing as a rule in ruptured ectopic pregnancies merely the large clots which can be picked up with the hand and I have yet to have a case in which trouble or disturbance has been caused after such treatment. I recall the case of one young woman who had considerable blood in the peritoneal cavity which was left and she made an uneventful recovery.

Not long ago a man was injured by the fall of a heavy automobile across the abdomen. I operated and found about a pint of free blood in the abdominal cavity. I stopped the hemorrhage and allowed the blood in the cavity to remain. The patient made a good recovery. There is no question but that the presence of free blood in the abdominal cavity is without harm.

DR ARTHUR H. CURTIS. With reference to rubber packing in abdominal surgical work it is unquestionably valuable. Dr Gellhorn of St. Louis uses heavy material and is responsible for the change from comparatively light to heavy rubber. As a

result of a considerable experience we have found that packing of the size and shape passed around for your inspection is the one most suitable for work in the average patient.

I would like to call your attention also to the use of the rubber pack in case one desires to use some sort of packing in the vagina. We employ radium a good deal and in practically all radium cases up to the period of six months we pack the vagina with gauze in order to give us adequate protection and we found almost as a routine that there were a considerable number of vaginal adhesions. I think that almost no case escaped. Since that time I have been using the rubber pack instead of the gauze pack and have not encountered a single case in which there was adhesive vaginitis. It has occurred to many of us in obstetrical work that if one wishes to introduce rubber as a pack or packing a very considerable gain can be made in packing the lower uterine segment and the cervical canal with rubber rather than with gauze. It becomes much less foul, is not so adherent, is easily removed and causes no distress whatsoever.

DR BERTHA VAN HOOSSEN. I was delighted to hear what Dr Watkins had to say with reference to the initial dose of scopolamine morphine in doing away with the dread that patients have in coming to the operating room and it occurred to me while he was speaking that he might be interested in knowing that this dread in going to the operating room is really equally surpassed by the dread that patients have of the preparation for operation. So many patients for many years have confided to me the very great shock and dread of the preliminary preparation the day before or evening before the operation that I have now adopted the method by which all patients are enabled to secure a good night's sleep free from any of this shock to which we used to subject them. For instance patients are entered in the afternoon say three or four or five o'clock, they are given a cup of tea for supper then given a colonic flushing and nothing more is done. They have the night absolutely free without any shaving any douches or without any previous exhaustion from the administration of cathartics. In the morning they are given $\frac{1}{16}$ grain of morphine and $\frac{1}{16}$ grain of scopolamine and in an hour this is repeated. In 15 minutes after the second dose the patient is taken to the operating room is shaved not by a young nurse who does not know how to wield the razor and maybe has a dull one but by some one who is more competent to use a razor so that the patient is in better shape in the operating room to proceed with thorough preparation. The third dose is given in the operating room and then she is given two drops of equal parts of ether and alcohol or two drops of ether in chloroform according as the anesthetist prefers. In order to get over this test of postoperative pain instead of waiting until the patient is nervous with pain we begin after the last dose of scopolamine is given to administer $\frac{1}{16}$ grain of scopolamine and $\frac{1}{8}$ grain of morphine. If you

give th t d se in a e e pain you ill find it is in efficient. However to the patient who has not yet become accustomed to the pain that his a very wonderful effect. In four hours this is repeated that is a grain of scopolamine and a grain of morphine is repeated every four hours until midnight of the second night.

In looking over our records at least once a month and sometime oftener and taking them at random and then reading in the laparotomies, perineorrhaphies, hysterectomies and many other operations we will probably not find a single case where it is said the patient did not sleep well the first night. The record states that patient slept fairly well or the patient slept well in the last demonstration. The patient has a history of a recent operation which he told after the laparotomy case the first night or the second night. Probably they are none of both.

There is another thing I want to mention and that is the arthritis. This subject is touched upon by Dr. Watkins. I feel perhaps that I have read a tag of my men that patients have a little more freely than they would to me. There is something that causes the trouble. There is a stimulus in the sexual gland which causes the sympathetic nervous system to be disturbed. That the chain between the nervous system is interrupted and that the interpretation that causes a certain degree of nervousness and irritability and a condition that perhaps is a tendency of the patient but the physician is not to consult a doctor many times and he is considered to be a then case and his nervousness is brought out and known to be a case. But in this case in which the mental condition of the patient is preliminary it means that the case is a preliminary condition in this chain. The chain has not been broken and patients are thus benefited.

Dr. J. I. B. R. J. ut a d concerning the patient. It has been my personal experience that the nitrous oxide is a most satisfactory method of day has a much quicker and effective than the nitrous oxide that nearly all of us use in the case of the patient. Why then I do not know. I have discussed the physiological and chemical and they do not know but unique in the history of the patient. The patient is the one who is the most valuable and they tell us that they are patient who fail to go to sleep almost instantly. Here is those of us who are frequently in the nitrous oxide here in the nitrous oxide. In the nitrous oxide occasionally find that the patient is preliminary in the nitrous oxide. The patient is most interested in the nitrous oxide. The oxygen demand is that too. I think account for the excellent results in the clinic. As I understand it they are most valuable in the nitrous oxide. The premises.

I should like to ask Dr. Watkins whether it is his

routine in gynecologic work to examine and remove a suspicious appendix whether he explores the upper abdomen and the gall bladder and whether he removes tone from a quiescent gall bladder without symptomatology? Furthermore whether in his removal of tubes and uterus by supravaginal hysterectomy having one or both ovaries behind he has never noticed a disturbance in circulation in the ovaries making it necessary before closing the abdomen to remove the ovaries as well as aside from the risk of ultimate cystic degeneration?

Dr. Watkins (closing). I believe Dr. Van Hoesen's remarks relative to giving anodynes in small doses after abdominal operations and commencing the use of belladonna becomes severe is a valuable procedure. I am firmly convinced relative to the physiology of ovulation and menstruation that menstruation is of absolutely no value except in its relation to reproduction that menstruation is largely accidental in that it permits the uterus to return to its normal state after it has been displaced in pregnancy (tear of blood). It is our custom always to examine the appendix and usually to remove it. Our experience is that it is generally diseased in case of severe pelvic disturbances (gall bladders) and always examined and gall stone is invariably removed unless there is some special reason for not doing so. We have had a large number of gall stone cases complicated with pelvic disease for the last two or three years. We have been interested in the fact that patients with pelvic disease complicated by gall stones frequently do not give a history of digestive disturbances before operation but that later they almost invariably recall stomach symptoms. One case recently gave negative stomach symptoms in the history records taken before operation. After the operation she gave a history of having had stomach disturbance of having had jaundice, biliary colic and having had a diagnosis of gall stones made.

We have the consent of the patient in operating before operating to do whatever seems necessary at the time of operation.

As regards disturbance of the blood and nerve supply of the ovaries we never remove the fallopian tubes unless they are diseased on account of making a disturbance. With care however the tubes can probably be removed without seriously disturbing the ovary. We have not had any special disturbances with the ovaries after doing hysterectomy for fibroids as Dr. Heaney has mentioned and believe that such disturbances of the ovary after operation are well generally means the presence of a chronic infection. Cystic ovaries which occasionally occur after operation should be treated conservatively as they generally disappear spontaneously.

In regard to the after care we believe that a large amount of fresh air freely circulating through the room is of great value as it relieves the nausea and vomiting 50 per cent and is a valuable nerve sedative.

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS IN SURGERY

EDUCATING the physician of civil life of today to become a military surgeon tomorrow is a tremendous task, one might say impossible, yet in answer to the call to supply the physician with works on military medical science in order that this may be made possible in a manner of fact we have before us a number of most instructive works. Many are entirely new, others are revisions of older editions with this point in view.

Much as we knew in regard to infections, their bacteriology and transmission, and the manner of dissemination through the body, yet at the beginning of this great war we as a profession were practically helpless in their active treatment. Drainage was instituted and the patient allowed to shift for himself as best he could by the assistance of his resistance. The constant presence of infection in war wounds with the resultant high mortality in anatomic parts and in life itself immediately stimulated surgeons and chemists to arduous study in the endeavor to find some way to curb the activity of this ever present and destructive host. Today we have in all probability a solution to the problem. The work of Carrel¹ is known throughout the world and its essentials in brief as bearing on infected wounds are well essayed in the little book at hand. The authors call attention to the necessity of exactness of detail in the treatment of wounds and their proper study in order that such treatment can be carried out intelligently. Success depends on several factors: first, the correct surgical cleansing of the wound; second, correct chemical solutions; and third, proper instillation of the antiseptics.

The method of preparation of Dakin's hypochlorite of soda is given in Chapter II following this the technique of wound sterilization, the time and technique of mechanical cleansing of the wound, and the placing of the instillation tubes and methods of instillation of the fluid. They describe the methods of bacteriological examinations in detail and the value this has in the treatment of the wound. A chapter is devoted to the closure of wounds and the results are given in a final chapter.

One cannot suppress a great enthusiasm derived from reading this book. Here we are given real scientific methods for the treatment of infected wound with results that seem almost miraculous and all within the reach of any surgeon who may diligently follow certain simple procedures. Many

details in the technique seem unimportant but upon the thoroughness with which these details are observed depends success or failure. J A W

DUE to the fact that a considerable portion of the detail in the technique for continuous application and instillation of Dakin's solution must be carried out by the nurses or attendant, Mme. Carrel's little book² was prepared especially for the purpose of aiding the attendant in the simple steps of the technique. It is a brief synopsis of the technique prepared especially for the nurse. The authors describe the materials used in the various dressings and apparatus for the instillation of the solutions, how these solutions are prepared and how best to assist the surgeon doing the dressing. Many illustrations are given for the purpose of guiding the reader. The technique of a dressing is described giving the materials used, the manner of placing the properly chosen instillation tubes and the attachment of the irrigator. In an appendix Dakin's fluid is described giving methods of preparation and titration. Appendix II describes the microscopical examination of war wounds by the Carrel method. In closing an English and French glossary is given.

J A W

WHEN different authors express their views on a subject one is greatly impressed to find repetition. It means as a rule that definite results are obtained. In going over the text of Keen's work³ we find much regarding the Carrel method of treatment of wounds. Many illustrations are taken from the previously mentioned book and he describes from Carrel's work the technique as presented by the originator. A brief resume is given of conditions encountered in the present war which differ from those of other wars.

The subject of tetanus, gas infection and gas gangrene are taken up briefly showing the advances that have been made in prophylaxis and treatment. The author calls attention to the production of the antitoxins to prevent gas gangrene by the Rockefeller Institute. Wounds of the head, chest, abdomen and joints with a synopsis as to their treatment are briefly mentioned, also the paraffin treatment of burns is discussed giving formulae for

TECHNICAL INFORMATION
CARREL M. TR. By J. D. M. T. A. C. I. Auth. p. dt. 1
t. by Adm. V. S. Lamb. rt. M. D. W. th. t. dt. n. by W. W. K.
M. D. L. L. D. F. R. C. S. (H.) N. W. Y. K. P. I. B. Hoebe. 97
THE TREATMENT W. W. bs. By W. W. K. M. D. I. L. D.
Ph. D. lph. a. d. Lo. l. W. B. s. d. C. mp. y. 97

THE TREATMENT OF I. C. W. N. By A. C. I. D. G.
D. H. T. I. t. d. by H. b. f. Ch. l. d. R. A. M. C. W. th. I. t. d. t.
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o f c a m p t e s s a n i t a r y o r d e r d i t l i n g a t a b l e
g i v i n g c a l o r c v l u e s a n d t h e l a t e a l u o f t h e
a r m y f o o d s T h e s b j e t f v t e a n d d i s p o s a l o f
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s i d e r e d C h a p t e r I I i s g i v e n o v e t o t h e m a r c h

Here again attention is called to waste as to the
amount given each man when he should have it
as to purification In the chapter on trench
and the battlefield the matter of disposal of waste
and the is argun considered also the diseases peculiar
to this form of warfare are discussed The subject
of insects concerned in the transmission of disease
is taken up in a chapter giving especial attention
to the flea mosquito flies lice and the manner of
eradicating of the pests A final chapter is given to
notes on transmissible disease giving a brief
summary of the infection and contagious diseases
how they may be detected the manner of dis
semination and the manner he treated to eliminate
carriers and source of contamination

Throughout the edition many army orders
illustrating conditions on which they may be met This
edition is a valuable text the medical officer in meeting
conditions they are today in warfare J A W

THE physician of civil life can scarcely compe
hend the great task before him on entering
military life One need only glance over the pages
of this work to realize the manifold details of
my life the many pitfalls to the soldier which
jeopardize his health and life all of which must be
monitored controlled by the medical officer For dis
eases which are approved for publication by the
Surgeon General of the United States Army are
basically the general principles for field hygiene and
sanitation When one remembers that in past
years the mortality from disease as in many cases far
in excess of that from powder and shot that a mis
take has been defeated military projects lost nations
destroyed by disease alone then the importance
of sanitation soon appears as one of the most if not
the foremost problem of military organization

The author attempts to give the medical officer
who is unfamiliar with his new duties a general idea
of the all important duty which confronts him The
omission of even a detail may lead to unnecessary
loss of life and greatly impair the efficiency of the
command

In a chapter on personal hygiene the author
makes use of the experience gained in the Mexican
affair and from observations abroad describes the
personal care of the soldier Every detail is given
the cause of the hindrances loathing the mouth of
rest proper food ventilation recreation the de
struction of vermin and many other items which
might appear to be details but which to the soldier
are real issues are discussed

The march is described as to the distance to be
covered by the various branches of military service
and the precautions used by the medical officers for
his troops the water and food supply being im
portant items

In camp life the proper site for camp the dis
posal of sewerage and a table for ventilation is

A H o o A l l H r y f r e s d D k D s c
F I C F R o o A d a r d a h u l b a n M D N s l T h
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F E B S T A M F I D H C l i M C U A P h l d l p h H P
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tents and houses sanitary kitchen mess halls and storage houses for food are considered. Much detail is given regarding the proper construction of latrines and incinerators and the method used to prevent and overcome the fly pest. The water problem is always a mighty one in army life. The author gives the amounts necessary for each man and beast the method of procuring it and of assuring safety in its use. He describes the method of purifying inclining toward the use of halazone for sterilization. In a discussion on camp diseases the usual diseases of the present war are briefly discussed. He divides them into filth diseases insect borne disease diseases spread by discharges from the nose and mouth and diseases caused by exposure. In an appendix are given illustrations and drawings of bath house mess halls kitchens latrines and crematories hospitals and houses ice boxes and the like. One must say the detail in the little work is enormous and invaluable to the medical officer.

J A W

THE intensity and magnitude of the present war bring us face to face with many new conditions. In the realm of medicine probably no one phase is of more interest than shock. Eder¹ in his little volume reports in detail 100 cases of war shock with their clinical study and treatment. He accepts the classification of Freud and divides them into conversion hysteria which includes the affections of the senses and locomotion fits and so on anxiety hysteria where the condition of dread anxiety fear is the prominent symptom and is due to some repressed unconscious mental complex and psychoasthenia. Of these 100 cases 79 received suggestion under hypnosis 5 received suggestion without hypnosis 6 received suggestion under anaesthesia 5 received psychoanalysis 2 received other methods of treatment and 3 cases received no treatment but were simply diagnosed. Of the 100 cases 97 were treated and of the 97, 80 are cured 14 are improved and in 3 no change noted. It is interesting to note the psychological mechanisms in these cases and the manner of study and analysis.

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In conclusion the author states that war shock is hysteria occurring in a person free from hereditary or personal psychoneurotic antecedents but with a mind more responsive to psychical stimulus than the normal. The wrenching from customary calling and life the new discipline the peculiar and terrible mental strain of modern war conditions acting upon this sensitive mind determine the disease among soldiers. Shell shock gas poisoning or other physical injuries do not cause the disease. The symptoms are protean palsies analgesia amblyopia mutism deafness affections of the vegetative system such as the soldier's heart vomiting diarrhoea insomnia loss of memory somnambulism phobias and obsessions of all kinds. These symptoms are the result of mental conflicts or other mental phenomena all the symptoms can be understood in terms of the mind without any reference to psychopathology. The treatment par excellence is hypnotic suggestion.

J A W

THIS compact volume is issued as Medical War Manual No 2 under the authorization of the Secretary of War and under the supervision of the Surgeon General and the Council of National Defense. Its contents comprise the first of a series of lectures delivered at the Army Medical School in Washington the author laying claim to but little that is original the material having been collected from various official publications. Its chief value lies in the fact that this material is unusually well formulated and most concretely and explicitly set forth until such important subjects as Organization and Administration War Surgery and Sanitation have been boiled down to a mere 11 pages and that too of such a size that the entire book may be carried in the medical officer's blouse pocket. The illustrations are simple outline drawings and are entirely adequate. None but an officer of the long practical experience such as the author has enjoyed could have reduced the subject to its simplest terms so successfully. More than ever at this time will this volume be found to be not merely valuable but essential.

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BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the lender. Selections will be made for review in the interest of our readers and as space permits.

MEMORANDA ON ARMY GENERAL HOSPITAL ADMINISTRATION. By various authors. Edited by P Mitchell M D (Vberd). Lieut Colonel R A M C (T F). London: Bailliere Tindall & Co.

TRANSACTIONS OF THE AMERICAN GYNECOLOGICAL ASSOCIATION. Volume 42 1917. Philadelphia: Wm J Dornan 1917.

THYROID AND THYMUS. By Andr Crotti M D. FACS LL D. Philadelphia and New York: Lea & Febiger.

THE SPLEEN AND ANEMIA. By Richard Mill Pearce M D Sc D with the assistance of Edward Bell Krumbhaar M D Ph D and Charles Harron Frazier M D Sc D. Philadelphia and London: J B Lippincott 1917.

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AMERICAN COLLEGE OF SURGEONS

HEADWAY TOWARD HOSPITAL STANDARDIZATION

STAFF members of the American College of Surgeons are now engaged in six states in the Union upon the hospital survey of the College. While it is still too early for a detailed report of progress it seems worth while here to state some of the questions being asked by the hospitals concerning the work and to answer these questions.

First what is the purpose of the survey? Again and again the question is asked.

The purpose of the survey is to make for the better care of folk who are ill. It is to create in the medical profession and among hospitals an increasingly keen sense of responsibility in the care of patients. It is to help in making hospitalisms come true.

In these days men evade expression of sentiment and it is difficult to use seriously the word *glory*. But men *feel* glory nevertheless. They feel glory in action in fight for liberty, glory in the very privilege of life at a time when our highest spiritual inspirations fuse as never before into the day's routine. Sometimes such glory breaks through into adequate rhyme and produces a Homer, a man who had digested his morals. And now very much in the same way it seems that an aggressive earnestness of purpose on the part of the medical profession breaks through into an adequate analysis of its own performance. That is hospital standardization. It is digestion of morals in the practice of medicine. It is an awaking of a spiritual impulse which compels action.

But if we are agreed upon the results we want, what action will produce those results? There is doubtless more than one good answer to this question. The answer of the College is published in Bulletin Vol. III No. 3. Briefly the College asks: What does the hospital do for its patients? Do the trustees and staff

from time to time review preferably in joint session the work done in the hospital in medicine, surgery, obstetrics? Do they use these data in a sincere effort first to get at the facts of successful work and of failures, second to remove the causes in so far as they can of unsuccessful work, and third to find in their own records and in their very association together some source of inspiration toward the fulfillment of their own highest purposes? On these matters the College seeks exact information.

Let us assume for example that the case records in surgery in a hospital during the past three months as they come before the trustees and staff indicate that 12 per cent of the patients developed infection during convalescence. The facts as to the percentage of infections may easily be determined from properly kept records. But obviously 12 per cent of infections is a serious indictment of the surgical service. Now let us assume that 90 per cent of the infected cases were patients of a particular surgeon. It seems reasonable that both the trustees and the staff should take a firm position that either this surgeon discover the cause of the infections and remove that cause or that he discontinue practice in the hospital. Further in this connection questions will naturally rise as to the nursing technique in the operating room. And again some one will ask: Are septic and clean cases operated upon one after another in the same operating room?

Too much emphasis in these reviews can not be placed upon the value of postmortem examinations. It is advisable that the pathologist report his findings in each postmortem together with the diagnosis and treatment of the case. Further the pathologist should report all deaths in the hospital during the period under review and what effort had been

AMERICAN COLLEGE OF SURGEONS

made in each case to obtain a postmortem where it was not made

Meetings of the trustees and staff should be held at regular intervals once in two months or three months or in such other period as these concerned believe wise. But it is important that the time for these meetings be definitely agreed upon and it is important that the review of the work done in the hospital during the period covered be fearless, accurate and constructive looking toward improvement rather than merely the finding of fault.

The statement is sometimes made in considering this matter that the staff can not be got together that the doctors would not be present at the meeting if invited. If such a condition is true it is a serious indictment against the governing authority of the hospital and against the honor of the staff. The product of the hospital is service to its patient and if the charged with the responsibility of creating this service can not with all incentive get together to consider their weaknesses and failures the situation is without thinkable justification.

Again the question is asked: What power has the College to enforce its plan of hospital standardization? The College has no legal political or financial power to make demand of a hospital. It desires no such power. It relies on its case in the patriotism and common sense of hospital folk and the medical profession. In the end too the whole program must go to the public for its judgment. But only in so far as the program is practicable and right does it merit acceptance or will it succeed.

The entire plan of the College is the outgrowth of years of thought. It is an effort on the part of the medical profession itself to make wiser progress to meet and to be worthy of the trust reposed in the profession by the public.

From some of the smaller hospitals comes the question: What will be the effect of hospital standardization upon the hospital

let us say of 50 beds? The question implies some feeling that standardization will tend to increase the usefulness of the large hospital at the expense of the small hospital. No valid reason has yet appeared which seems to justify such a conclusion. The merit of hospital service is not to be measured by the wealth of the institution its architecture or by the professional reputation of its staff. There is no reason why a patient should not receive as efficient care in a hospital of 50 beds or less as he would receive in a large hospital. Any readjustment which may be brought about by standardization as to the relation of hospitals to their communities will be solely upon the merit of service. The basic consideration is that each hospital large or small accept for treatment except in emergencies only such cases as it is by equipment and training of its staff honestly qualified to treat.

An exceedingly fortunate fact in connection with the work of the College is the standardization both of the medical profession itself and of hospital procedures now in effect in the medical service of the Army and Navy. Here thousands of physicians and surgeons under military exactness are being trained in professional efficiency. When the men return to their respective hospitals they will not willingly accept standard of less merit. The head of the medical division of a great base hospital under recent date writes:

The government does not expect a man to be perfect and is very willing to overlook error of judgment but it has no patience with errors due to neglect. The record must show in every case that every available resource for making a correct diagnosis and instituting appropriate treatment has been used.

There is a great deal that all of us who have had the experience of base hospital work can carry back to our home work with the greatest profit. Our hospitals will surely be the better for it!

SURGERY, GYNECOLOGY AND OBSTETRICS

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NUMBER 6

MILITARY ASPECTS OF THE SURGERY OF THE SPINE AND SPINAL CORD¹

BY CHARLES H. IRVING, M.D., F.A.C.S., PHILADELPHIA

AS the United States is now mobilizing its medical forces for service in the War Zone it seems appropriate at this representative gathering of surgeons that a major portion of the time should be given to the consideration of military surgery. Never before in the organization of the country's forces in preparation for war has there been such an effort to take advantage of the training and qualifications represented in the specialties of medicine so that the round peg will find the round hole and the square peg the square hole.

Neurological surgery has been recognized as demanding special consideration and to this end a school in neurological surgery has been inaugurated in Philadelphia by the Surgeon General to prepare a selected number to take care of gunshot injuries of the head and spine. Already one class has completed an intensive course; another course is now under way and arrangements are being made for the inauguration of courses in other cities.

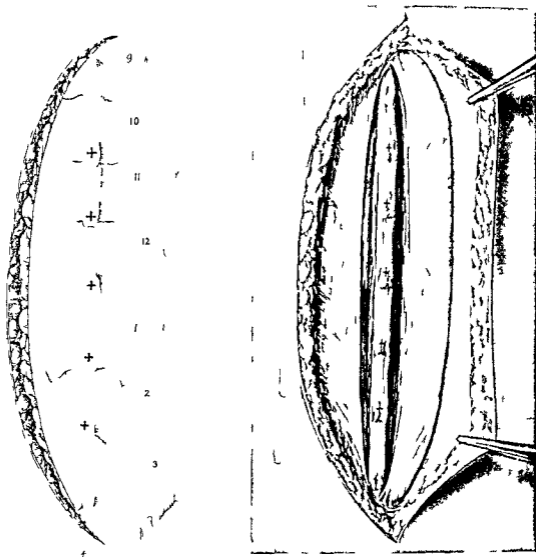
Rather pessimistic reports come to us as to the results obtained in the treatment of head and spine injuries. These may be justified in part by the inability to combat infection of the brain and cord as it has been so effectively done in the extremities and in surface wounds and by the lack of reparative power peculiar to the central nervous system. But I am told by those who have

been at the front that the high mortality rate must be attributed in part to crude and ineffective methods applied by those who have had little experience and training in dealing with lesions of the central nervous system. There would seem therefore ample justification for the plan for providing the opportunity for military surgeons to receive such instructions as will enable them to deal with greater intelligence and confidence with gunshot injuries of the cord, spine and peripheral nerves.

In the literature of the present war the surgery of the central nervous system has been the topic of many valuable contributions but relatively speaking the large majority has been devoted to the brain rather than the spine. But the subject of spinal cord injuries has by no means been neglected. My remarks this evening will be devoted to the consideration of those phases of gunshot injuries of the spinal cord as have practical import and value.

Wounds of the spine and spinal cord occur at every level although they are most frequent in the thoracic region chiefly because it is longer and therefore more exposed. Out of 642 cases of gunshot injuries of vertebrae recorded in the *Medical and Surgical History of the War of the Rebellion* 91 were in the cervical region, 137 in the thoracic, 149 in the lumbar, in the cervical and thoracic 3 in the thoracic and lumbar

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and in 60 cases the location was not stated. In a group of more than 300 cases seen by Gordon Holmes in the present war the injury most often affected the thoracic region and the cervical enlargement although he has seen every segment involved from the second cervical to the conus. In 65 cases the lesions were situated between the sixth and ninth thoracic segments and in the fourth fifth or sixth cervical segment in 51

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cases. According to Guillian and Barre the largest number of spinal injuries in the present war is due to shell fire. In their experiences 61 per cent were due to shells, 23 per cent to bullets and 8 per cent to shrapnel.

The bone lesion resulting from gunshot wounds of the spine are varied depending partly upon the portion of the vertebra involved and partly upon the shape and velocity of the projectile and upon whether it has ricocheted or followed a straight course.

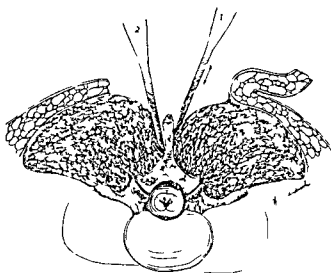


FIG. 3. Separation of the muscles from the tip of the spinous process.

Fractures of the compact and thin parts particularly the arches spinous and transverse processes are common. The same projectile particularly if it be a ricocheting bullet may involve several arches and their processes and if its power of penetration be sufficiently strong at the point of impact it may cause indirect fracturing of the arches and processes immediately above or below those directly involved. Associated with these fractures there is considerable splintering and fissuring of bone. Indeed the force of impact and velocity of the modern bullet are so great that dislodged spicules of bone and metallic particles of the projectile itself and bits of clothing may be carried forward into the spinal canal.

The bullet may strike the spinal column anteroposteriorly instead of in the more usual posteroanterior direction. In this case there is usually in addition to the spinal injury a wound of the pelvic abdominal or thoracic viscera. The bone lesion is not so severe however as gunshot injuries seldom cause a comminuted fracture of the vertebral bodies. The bodies of the vertebra are less compact and therefore are perforated, notched or fractured by the projectile in a more or less clean cut fashion. If the course of the projectile be transverse or oblique the transverse and articular processes are chiefly involved.

While the bullet may become lodged in the vertebral bodies in the lamina or other pro-

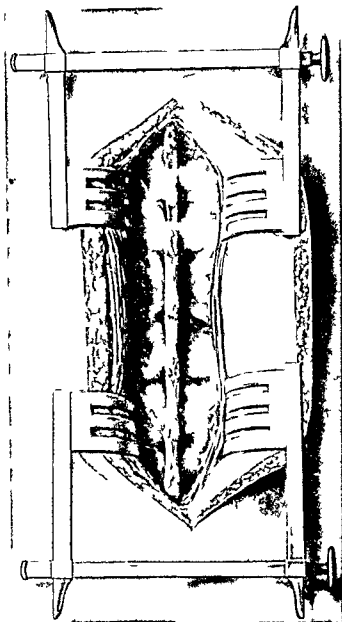
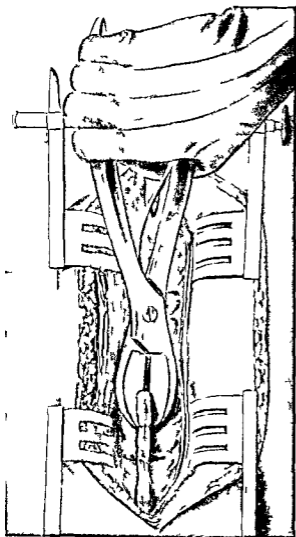


FIG. 4. A pair of self-retaining retractors introduced on the upper and one at the lower end of the

processes or in the vertebral canal it more often happens owing to the greater momentum of the modern projectile that the bullet either passes through the entire spinal column or in case the bone at the point of contact be more resistant it may rebound without penetrating the bone and become embedded in the soft parts at some distance from the spine. Occasionally instead of remaining in its original location the bullet sinks to a lower level of the canal.

The cord may suffer in a variety of ways both directly and indirectly. It may be



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severely lacerated or even completely severed by direct contact with the bullet or indriven piece of bone it may be compressed by displaced fragment of bone by the bullet protruding into the canal by a subdural hemorrhage by adhesions or serous exudates it may be contused by the bullet and accompanying splinter of bone finally the cord may undergo grave structural changes from the effects of concussion or commotion caused by a bullet striking some portion of the vertebral column and bounding back to become lodged in the soft parts or the sudden atmospheric changes produced by exploding shells may result in changes

The structural changes in the cord the result of laceration contusion or compression have been described with great faithfulness not only those at the site of impact but those remotely situated. In many respects the pathological changes do not differ materially from those observed in civil injuries consequent upon fractures they are chiefly edema hemorrhage primary destruction and secondary disintegration.

Considerable interest and speculation have been aroused as to the mechanism of a spinal concussion. The term concussion as applied to the brain implies a condition in which while there may be all grades of functional disorders even to complete functional arrest and death the absence of gross or microscopic changes in the brain is conspicuous. In spinal concussion however obscure and speculative may be the manner of its production structural change even to the point of complete disintegration are a more or less constant feature.

In most cases of spinal concussion the bullet strikes the vertebral column and rebounds to become embedded in soft tissue or an organ often at some distance from the spine. The momentum of the modern bullet is so great at the time of impact that the vibratory force is transmitted to the cord with damaging effect. Many explanations have been offered as to the cause of these changes. While in some momentary displacement may be a factor the pathological lesions of concussion are not those common to fracture or dislocation. The effects of concussion have been attributed to the waves of pressure set up in the spinal canal and the disturbance of the lymphatic circulation caused by the concussion. According to Fickler the cord is made to oscillate within the canal at the time of impact and since its movements are not synchronous with those of the column it may be directly injured by contact with the walls of the canal. The displacement of the cord would easily account for histological changes in the roots.

Whatever the mechanism may be the fact remains that spinal concussion produces both definite and serious lesions of the cord characterized by their diffuse and irregular

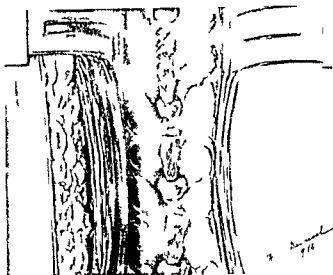


Fig. 6 Exposure of the vertebral column after the posterior processes have been removed

manifestations. These processes include oedema, hematomyelia, hématorachis, disseminated foci of necrosis, softening and cavity formation and parenchymatous changes, often over four or five segments in either direction.

There is still another group of cases in which the clinical picture and the autopsy findings show grave involvement of the spinal cord but in which there has been neither a direct nor an indirect injury to the spinal column. These are attributed to the sudden changes in atmospheric pressure caused by the explosion of the modern shells and grenades. The victim immediately falls to the ground with all the signs of a partial or complete transverse lesion and autopsy may reveal the various macroscopical and microscopical changes above mentioned.

Accurate localization is essential to the success of operations upon the brain and cord and I think this statement is if anything more true of the cord than of the brain. It is important therefore that we should inform ourselves as to all the physical signs that have to do with the exact localization of the lesion, the exact determination of the level of the injury. Here again we are reminded of the necessity for specialized service. Neurological examinations are tedious and time consuming and for their accurate performance require training and experience. Furthermore, not only one but repeated

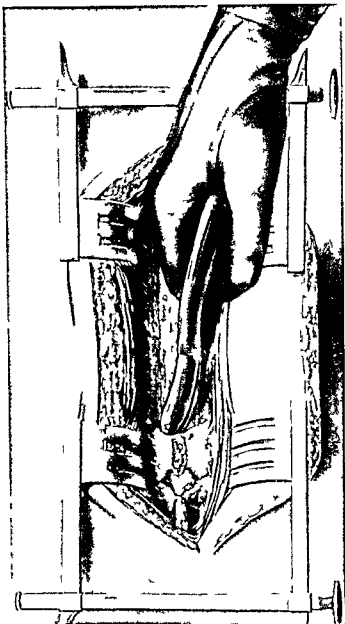
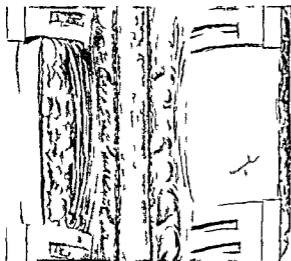


Fig. 7 Removal of the lamina

examinations are required in individual cases before resort to operation is determined. In the general hospital with the rapid influx of patients and the necessity of hasty evacuation, how little opportunity there is for the painstaking service and study which those suffering from injuries to spine and cord require. Possibly because of the indifferent treatment of these cases in the general hospital, England has attempted segregation, and it is hoped that this country will find it possible to erect in the War Zone hospitals to be devoted exclusively to injuries of the central nervous system. At the time of our



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Civil War the Surgeon General ordered the establishment of a special hospital for the treatment of diseases and injuries of the nervous system and even then it was considered essential to the care of the patient that the surgeon and the neurologist work hand in hand.

To Cord N. Holmes, the distinguished neurologist more than to any individual observer are we indebted for the accurate portrayal of the clinical picture of cord lesions, more particularly in regard to localization, and from his contribution I have drawn freely in the presentation of this phase of the subject.

The cord symptoms vary according to the nature, the extent and the extension of the lesion. We may recognize four groups.

Group 1 comprises the complete transverse lesion with total and absolute flaccid paralysis below the level of injury with abolition of all reflexes in all forms of sensation.

Group 2 includes the partial lesions the spinal hemiplegia or the more or less typical Brown Sequard syndrome.

In Group 3 may be placed the lesions of compression characterized by spastic paraplegia exaggerated reflexes and positive Babinski.

Group 4 comprises the lesions of the cauda equina.

In the past we have been in the habit of laying more emphasis on the upper level of sensory disturbances as indicative of the level of the lesion than upon the evidences of motor impairment. As a matter of fact in many instances the sensory disturbances are more difficult of interpretation and less useful therefore than the motor. While we have recognized the localizing value of paralysis of isolated muscles or groups of muscles in the upper or lower extremities the diagnostic value of paralysis of muscles in the trunk has been overlooked. Holmes believes this to be of great value in making a topographical diagnosis of lesion of the six lower thoracic segments. For example if the eleventh segment be involved we find paralysis of the lower portion of the external and internal oblique with bulging of the iliac regions while the whole rectus abdominis contracts when the patient raises his head or coughs. If the ninth segment be affected the lower part of the rectus abdominis is paralyzed while the upper part contracts vigorously. The condition of the intercostals is also very valuable in the localization of lesions particularly of the upper thoracic segments. By placing the finger over an intercostal space the muscle will be felt to contract strongly on each inspiration if it be not paralyzed. This is a valuable guide since each intercostal muscle receives its nerve supply from the corresponding thoracic root.

While accurate charting and interpretation of the sensory disturbances is an aid in making a topographical diagnosis there are by no means infallible particularly in cases of incomplete or unilateral lesions chiefly because of the decussation of the sensory fibers and their oblique course within the cord. It should be borne in mind moreover that the decussation occurs quickly in the midthoracic region gradually becoming slower as we go upward. Certain phenomena such as the lowering of the upper level of anesthesia and the escape of early reappearance of sensation in the caudal region have given a new insight into the arrangement of the sensory fibers of the second order as they ascend through the ventrolateral column.

According to Holmes they indicate a lamellar arrangement in which the fibers that carry any specific form of sensation from successive dorsal roots lie in series and as there is a general law that the longer descending fibers lie nearer the periphery of the cord those that convey impressions from the lower spinal roots are probably placed lateral to those that have later reached the contralateral side. The escape of the sacral root areas would therefore indicate a lesion that involves only the more medial fibers of the sensory path while an anesthesia disproportionately low in relation to the level of the spinal injury would suggest a local destruction of its more lateral fibers. When it becomes possible to correlate the exact histological changes in these cases with the results of careful clinical examinations definite conclusions on the exact course of the fibers that carry various sensations from different regions of the body will be possible.

Holmes has found the disturbance of deep sensations particularly the sense of vibration a help in those cases of lesions limited to the dorsal columns in which the sense of touch and pain is unaffected. In these cases the vibrations of a heavy tuning fork are not recognized below the level corresponding to the injured segment. Since the thorax may act as a sounding box the fork must be applied in this region only to folds of the skin which have been raised. On the other hand in cases of unilateral lesions in which pain and temperature sensation are completely lost those forms of sensation conducted by the dorsal columns are often intact. In some cases homolateral astereognosis has been found to be present when tactile sensibility was otherwise unaffected. In incomplete transverse lesions anesthesia to pain and temperature is almost invariably present while tactile sensation may be preserved. Above the twelfth thoracic segment unilateral lesions take the form of a more or less typical Brown Sequard syndrome. The studies in the present war seem to corroborate the views of Hurd and Thompson that thermal stimuli of all degrees are conducted by the same intraspinal paths but that heat and cold are conducted by separate fibers.

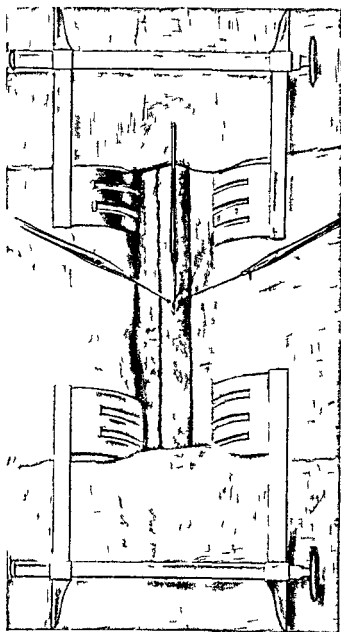
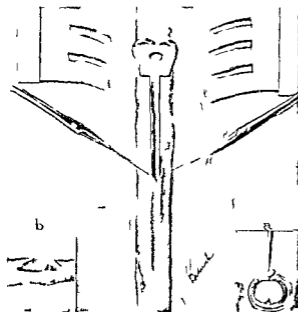
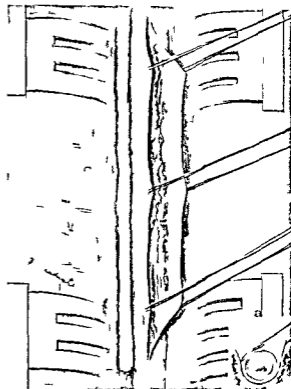


Fig. 9. This illustration shows the general appearance of the operation held before the dura is opened. The musculocutaneous structures do not to the level of the dura are entirely covered with gauze pad. Traction sutures are introduced in but not through the dura as the incision in the dura is begun.

As indicative of lesions between the second cervical and second thoracic segments are the symptoms which result from disturbances of the cervical sympathetic: the myosis or inequality of the pupils, the narrowing of the palpebral fissure, the enophthalmos, the diminution of tear secretion, flushing of the face (especially after shaving) and diminution of sweat or relative dryness of the skin on the affected side.



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An interesting syndrome in lesions of the lower part of the cervical enlargement is represented by slow pulse subnormal temperature low blood pressure and scanty secretion of urine. The temperature in some case is lower than can be registered by a clinical thermometer the pulse rate from 40 to 50 rising or falling with the rise and fall of temperature and the urinary secretion sometimes entirely suppressed.

As an occasional symptom in lesions of the lower cervical and three upper thoracic segments Celler mentions persistent shivering of the face neck and shoulders without any sense of coldness on the part of the patient although a rise in temperature is a much more common accompaniment of lesions of the cervical cord.

In one case observed by Leyva the involvement of certain medullary centers was expressed in the paralysis of the recurrent laryngeal nerve in a unilateral atrophy of the tongue and difficulty in swallowing. Bilateral and unilateral paralysis of the diaphragm point to a lesion of the cervical cord as far down as the fifth cervical segment.

As significant of lesions of the thoracic segments of the cord I may remind you of abdominal distention in some case associated with muscular rigidity and more or less persistent vomiting. The association with the latter of girdle pains and hyperaesthesia of the skin between the ensiform cartilage and the umbilicus would indicate a lesion of the sixth seventh eighth and possibly ninth thoracic segments and remind one of the gastric crises of tabes in the relief afforded by section of the posterior roots of the corresponding cord segments.

Recently I have had under observation a patient with an acute inflammatory condition of the fifth and sixth thoracic segments in whom polyuria has been a striking symptom. The boy age 16 voided for several weeks from 150 to 200 ounces of urine per day due in all probability to arrest of function of the vasoconstrictor fibers of the kidney.

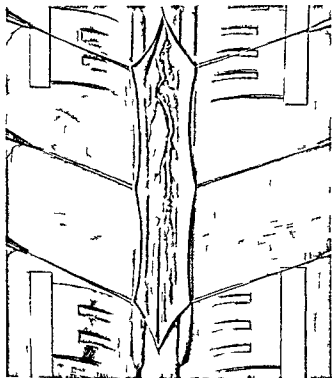


Fig 1 The appearance of the postoperative spinal canal. The dural flap has been reflected with traction sutures.

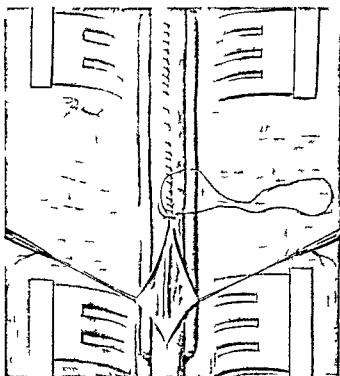


Fig 2 Closure of the dural incision with continuous suture.

The role of the X-ray in the localization of lesions and in revealing the extent and nature of the injury has been disappointing. A careful neurological examination has proved more reliable in determining the level of the lesion as the gravity of the skeletal lesion bears no relation to the degree of cord injury.

I recently examined two X-ray plates of gunshot injuries of the spine from the war zone. In the first plate two vertebral bodies appeared shattered but there had been no injury to the cord while in the other the plate showed no evidence of fracture or foreign body but the case presented all the symptoms of a complete transverse lesion. Fracture of the spinous processes or depressed fractures of the laminae are not easily brought out by the X-ray and even with stereoscopic pictures it is not always easy to determine whether a bullet lies within or without the spinal canal. However X-ray pictures should be taken routinely in the hope of eliciting the site of a bullet or the presence of a dislodged fragment and to determine if possible whether the bullet be within the spinal canal.

The treatment of gunshot wounds of the

spine is a complex problem. The momentous question in most instances is whether an exploratory laminectomy be indicated and if indicated how soon after the injury should it be performed. A judicial decision in these matters must take into consideration many factors: the facility for performing the operation, the presence of a complete transverse or an incomplete transverse lesion, the presence or absence of bullets or fragments within the vertebral canal, an open or closed wound, a direct injury to the cord as from compression or an indirect injury as from concussion.

Let us consider first the treatment of indirect injuries to the cord: those due to an explosion in the vicinity or to the impact of a bullet against the vertebral column without direct impact on the cord or to the passage of a bullet adjacent to but not involving the vertebral column. In this category it must be borne in mind that the interference with cord function may at first be quite as pronounced as when the cord is actually severed by a bullet. At the outset the picture may be one of a complete transverse lesion even though it be the re-

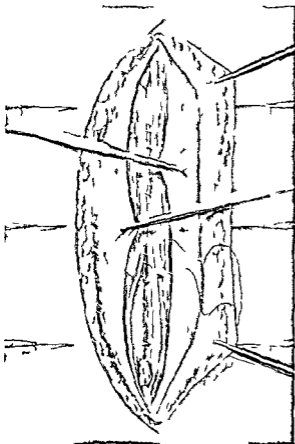


Fig. 5. Incision for laminectomy.

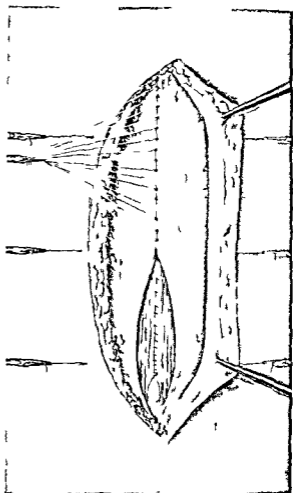


Fig. 6. Incision for laminectomy.

ult of necrosis alone. Under these circumstances early operation is clearly contraindicated. However, should the symptom persist without amelioration, an exploratory laminectomy under suitable circumstances may be considered within the limit of propriety on the ground that the persistence of symptom may be the result of hemorrhage or an undetected injury of the vertebral column. Be it remembered here, as in other part of this discussion, that the clinical evidence of a total or complete transection does not signify an irreparable injury to the cord. In fact, it often has the interpretation of the sign of a total lesion been found misleading, that surgeons are rather prone to size this as a valid argument in favor of frequent recourse to exploratory laminectomy. Along this line Armour puts the question: Are there any

symptoms by which we can in a reasonable time determine beyond a doubt that we are dealing with a case either of complete transverse section or of pure concussion? If there are not, then should not we be urged to give our patient the benefit of an operation which experience shows neither materially endangers his life nor adds to his discomfort but actually lessens his pain? It will at least afford us the opportunity to determine the exact nature and extent of the lesion and to place the cord under the most favorable condition for recovery of function if recovery be possible.

When dealing with direct injuries to the cord by bullet, shrapnel or bone splinter, the propriety of a laminectomy admits of little

discussion. This general dictum with certain qualifications has been subscribed to quite generally by neurologists and surgeons alike who have had opportunity for abundant observation during the European War.

While it may be true of the individual case as it is no doubt of a large number that the damage to the cord is accomplished at the time of the accident and that the persistence of symptoms is the result not of continued compression but of the intramedullary changes in the cord due to the original impact an exploratory laminectomy should be performed whether the picture be one of a complete or incomplete lesion.

One may assume that if the injury is due to shrapnel the cord is more apt to be hopelessly damaged than by a bullet. But after all the nature of the cord lesion is largely a matter of conjecture and there is the temptation to take the position endorsed as it is by Oppenheim that operation is indicated even in cases of total transverse lesion for there is nothing to lose and perhaps something to be gained. In twenty operations for gunshot injuries of the spine Guleka found the cord completely crushed in ten and while only five of the twenty cases recovered three of these would have died had not fragments of bone or bullets been removed.

As to the time of operation there are those who urge immediate operation and those who advise waiting from three to five weeks or until the likelihood of recovery seems remote. Whatever may be the view of the individual surgeon it is at least true that no operation should be undertaken until the patient has recovered from shock and not until the patient reaches a base hospital from which he will not have to be transferred until the fractured spine has been well repaired. Authorities agree that secondary changes are more likely to develop as a result of early transportation and therefore absolute rest is advisable in the convalescent period if the condition offers any prospect of useful recovery.

Included among the later indications for operation are the symptoms attributable to the pressure of an organized exudate of callus of a traumatic pychymeningitis or of a

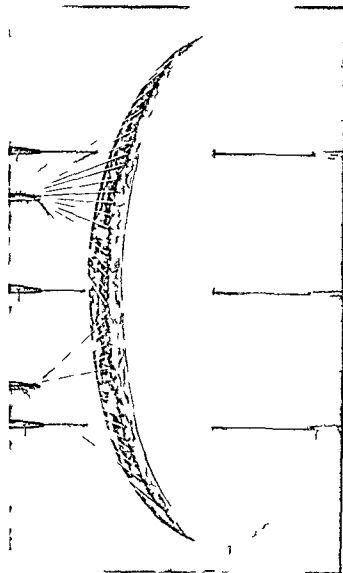
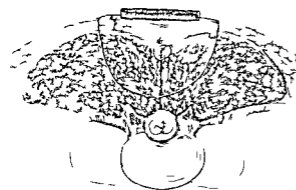


Fig. 6 Closure of the superficial fascia interrupted sutures the plant sutures through the muscle sheath remains undisturbed

circumscribed serous meningitis and in not a few instances the principal indication for operation is persistent and intractable pain.

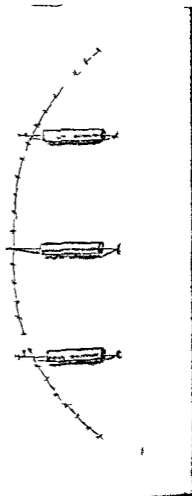
In matters of technique local anesthesia should be given preference whenever applicable the X ray report should be at hand X ray identification of an individual vertebra at the level of the cord lesion should have been made the incision should be planned to include at least three vertebrae and the dura should not be opened unless from marked distention or from discoloration there is reason to believe the bullet is within the dural sac. The various steps in the performance of a laminectomy are amply portrayed in the illustrations.



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Failing to find the bullet without the dura after a careful inspection on all sides the dura must be opened and the search continued. After the removal of bullet or splinter of bone lacerated or punctured wound of the cord and in some cases severance of the roots may be revealed but the futility of cord or root suture in the restoration of function is so well recognized that attempts at repair by suture though occasionally practiced are unwarranted. There seems to be a difference of opinion among surgeons with extensive military experience as to whether the dural incision should be closed in all cases. In deciding this question the surgeon must take into consideration two factors: one the presence or absence of infection in the bullet tract and the other the condition of the cord. As to the former every precaution must be taken to guard against infection of the subarachnoid space and if the wound be aptic closure of the dural incision is the safer course to pursue. In the absence of infection should the cord be so swollen and edematous that closure of the dural incision exert undue pressure a condition of rare occurrence the dural incision may be left unutured. On general principle leaving the dural incision open as a routine practice should be condemned.

To avoid infection of the bladder and the inevitable ascending infection the catheter must not be used. Either a suprapubic cystostomy which we have found so effective in civil practice may be resorted to or the



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bladder may be allowed to empty itself by overflow a practice which has become popular in many of the War Zone hospital.

Enough has been said to show at least the complexity of the problems involved in the surgery of gunshot injuries to the spine. The determination for or against operation cannot be made here with the same facility as with gunshot injuries to the abdomen where the physical signs are more sharply defined and may be elicited in a comparatively brief observation. Examinations for spinal injuries are time consuming and must be oft repeated and the segregation of these cases in a special hospital on the staff of

which is included a corps of expert neurologists would therefore seem to admit of no dispute. We have but to turn to the medical records of our own Civil War to find one of the most important contributions, the monograph *Gunshot Wounds and Other Injuries of Nerves* by Mitchell Moorhouse and Keen as the outcome of the co-operation between surgeon and neurologist.

Both in this classical monograph and in several historical papers written later Weir Mitchell has special emphasis on the fact that if out of the general destruction and calamity of warfare is to come any addition

to this branch of medical science any increase in our ability to relieve human suffering, it must come through concentrated minute study and observation on the part of both surgeon and neurologist and from faithful and detailed records. When he tells us that he and Keen spent night after night following upon days of toil writing their own records without aid of clerk or stenographer we realize what an example of service has been set us. We hope that we too in our generation out of the calamity of this great war may add our mite to the great healing science we serve.

OLD INJURIES OF THE SPINAL CORD¹

By WILLIAM B. KANAVLL, M.D. (CHICAGO)

SURGICAL intervention in injuries of the spine offers more hope for benefit than similar procedures in injuries of the skull. Both immediate and late operation in selected cases obtain results beyond what has been hoped for up to the present. These results are not to be secured however without painstaking attention to details of technique preceded by careful neurologic diagnosis. It should be emphasized that the slightest trauma to the cord does great harm. In the brain owing to the interrelation of various groups of cells and their wide distribution a fair amount of traumatization even with destruction may occur and the functions of the individual be unimpaired. In the cord however the bundles are so compact that the smallest actual injury is frequently followed by permanent impairment. Rough handling of the nervous tissue in an operative field is criminal on the part of the surgeon. The technical steps to be followed in exposing the cord have in the last few years become almost uniform in the hands of various neurologic surgeons. The removal of the spines and laminae by the quickest possible procedures, the protection of the subarachnoid space from extravasation of blood, gentle handling of the cord com-

plete closure of the dura, obliteration of muscle space and subsequent treatment without casts are too well known to merit further discussion this evening. In my discussion of Dr. Frazier's paper I shall confine myself to reporting briefly the results I have been able to obtain by operation on patients who have had spinal injury with involvement of neural tissue some months or years previously. These are grouped in two classes: those suffering from fracture and those suffering from gunshot wounds. The results obtained by operation immediately after injury while interesting present an entirely different problem since the question always arises as to whether or not the patient might not have recovered without operation. In late operations however we have findings indicating definite involvement of the spinal cord or nerves.

Owing to the brief time allotted me in this discussion the findings before operation will be presented by charts and a brief statement made as to the results of operation.

CASE 1. Mr. I. L., age 40, referred by Dr. Hamill, Wesley Hospital, fell backward 14 feet from ladder July 31, 1914. Entered Wesley Hospital September 26. Unconscious for one half hour after injury. Paralysis of leg and weakness of arms.

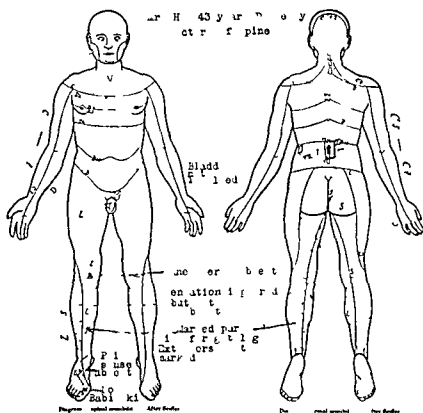


Fig. 3. Case 3. Fracture of spine.

6 days after fall became unable to use right arm. Could move both leg slightly. On entrance findings were as shown in Figure 1. Motion in right arm has improved during previous two weeks but he is unable to pick up anything with it. Left arm weak. Unable to pass urine for few days before entrance. Occasional sensations of heat and cold across abdomen and in legs.

Operation September 9. Laminæ of the fourth, fifth and sixth cervicals removed. Fracture of fifth cervical cord compressed by fourth cervical not pulsating. After the excess fluid was allowed to escape and the inflammatory exudate was removed the cord began to pulsate. Uneventful recovery.

Left hospital November 14 with no incontinence. July 1916 he was able to walk without support and to use arms and hands but some slight incoordination and weakness were present. Sensation had improved markedly although there was not a complete restoration. The patient has so far improved however that he holds a position as flaman.

CASE 2. W. W. age 36. Wesley Hospital. Referred by Dr. Mix. June 1915 jumped 15 feet from a freight train. He was conscious for a few seconds. There was immediate loss of motor power and sensation below hip. Twenty-four hours

later sensation began to return with motion of toes in left foot. Following the operation there were incontinence of urine, constipation and entire loss of sexual control. He entered the hospital June 8 1916 with findings as noted in Figure 1.

Operation June 9 1916. Laminæ of the twelfth dorsal and first and second lumbar removed. The first lumbar vertebra was fractured and displaced forward. Chronic pachymeningitis and leptomeningitis.

The patient recovered from the operation with a restoration of bladder function. There was some slight return of sensation and some improvement of motility. The patient is still a dependent and doubtless will never completely recover although improvement continues.

CASE 3. Mr. H. age 43 referred by Dr. Perry. Struck by automobile causing extreme flexion of the spine. Fracture of the second lumbar vertebra. He was unable to move right leg. Spasm about lumbar spine. At first there was a complete paralysis of all the muscles of right leg. Left leg slightly paralyzed but could move leg. Tactile sensation slightly impaired. Pain sense absent over the dorsum of foot. Tendon reflexes at knee and heel absent in right impaired in left. No Babinski.

Cremasteric reflex present. Early bladder incontinence now absent. Intestinal peristalsis marked for some days after injury. Atroscopy of right leg apparently atrophied to a considerable degree. Small bed sore present on scrotum. Finding as shown in Figure 3.

Laminectomy on tenth day. Fracture of the second vertebra found fractured and body impinging on cord.

Anesthesia which had been present disappeared at end of first week. Fourth week patient could walk with the aid of crutches. Sixth week walked with cane up and down stairs. Apparently complete recovery.

CASE 4. Mr. A. C. B., age 30, referred by Dr. Hamill, Wesley Hospital, July 19, 1911, knocked down by auto and dragged 15 feet. Unconscious for two days. After regaining consciousness he was unable to move legs from hips down. Weight applied to feet then plaster cast. Two weeks after injury was operated on at Grand Rapids, Michigan, but paralysis was not improved. No control of urine or bowels since accident. Large bed sore present November 23, 1915, when he entered the hospital. Findings as shown in Figure 4.

Operation December 7. Lamina of twelfth dorsal and first second and third lumbar removed. Cord apparently destroyed, surrounded by fibrous tissue. Patient died ten days after operation of acute pyelonephritis. Wound and meninges not infected.

CASE 5. H. G., male, age 6, farmer, referred by Dr. Church. Seventeen months before entering the hospital the patient fell 15 feet from roof landing upon both feet, resulting in acute sharp and excruciating pain in the lower part of the back. Elapsed into unconsciousness 40 minutes after the accident, lasting 2 hours. Tingling, prickling and numbness appeared over both legs followed by cramps, constipation and urinary retention necessitating catheterization for 3 weeks when incontinence of urine (overflow) and involuntary bowel movements occurred and continued up to time of entrance. Sensory and motor changes persisted as shown in Figure 5.

Diagnosis: compression fracture of second lumbar vertebra.

Operation April 4, 1917. Laminectomy of twelfth dorsal, first second and third lumbar.

Transplant of fat wrapped about nerves. Patient discharged in 40 days. Impairment of sensation distinctly less. Motor power undoubtedly improved. Bladder control restored. Patient markedly benefited by the operation.

The results in these cases clearly demonstrate that all old cases of fracture of the spine should be subjected to careful study as to the advisability of operation. Where the

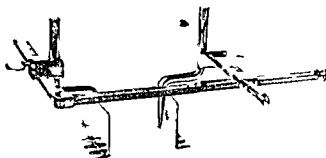
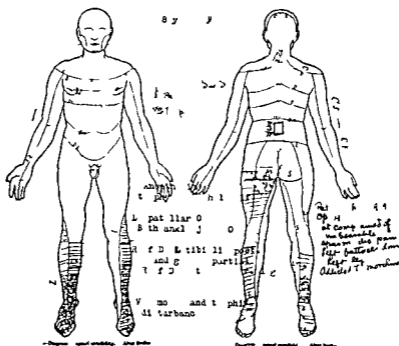


FIG. 1. Author's retracter for use in laminectomy. Not flexible, preventing slipping. The angle of the retracter's handle keeps the retracter out of the field and the holding of the handle up and down to accommodate the lumbar and dorsal curves.

paralysis and loss of sensation are nearly complete with incontinence of urine, little is to be hoped for if the lesion is above the cauda, particularly if it is over the dorsolumbar reflex centers. In patients with a lesser degree of injury, more often if above the dorsolumbar centers and particularly if below them, operation should be considered most seriously. The cervical fractures are particularly prone to present hemorrhage within the cord; consequently this should be remembered in making a decision as to operability. In my experience these cervical injuries, even below the third cervical, are particularly prone to fatal issue. In this connection I am reminded of three cervical fractures occurring on my service at the Cook County Hospital, all within three weeks, one of the fourth and two of the fifth cervical vertebra. All were apparently in good condition for 24 hours and yet all died suddenly in the second 24 hours with increase of temperature and evidence of involvement of the medulla. Whether this result followed an edema or hemorrhage I do not know, but they emphasize the serious nature of these injuries. Undoubtedly the most favorable cases are those presenting fracture below the lower dorsal reflex centers. Here of course the lesion most often presents the great irregularity in its symptomatology associated with caudal lesion, yet were it nearly a complete involvement, an early radical operation would hold out considerable hope for great relief and one would be inclined to urge it in all such cases.



I C 6 Find g n t

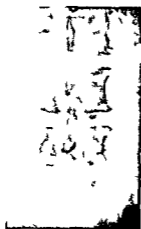
One case not reported here owing to the fact that it has been so lately operated upon presented a restoration of bladder function after four years of incontinence.

In these old case with bladder involvement one must always expect a pyelitis. From this death occurred in my one fatality following laminectomy. One patient (W W)

on the morning of the proposed operation developed a chill and a temperature of 103, necessitating delay in the operation and emphasizing that temperature and chill after operation may not be due to infection of the operative field.

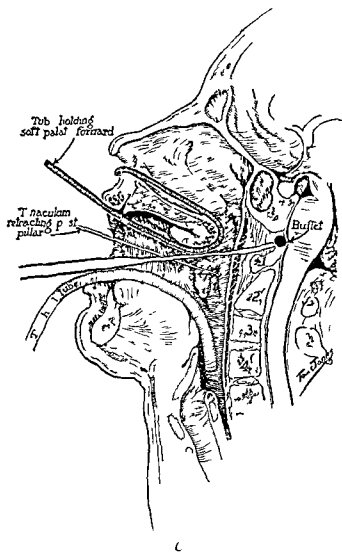
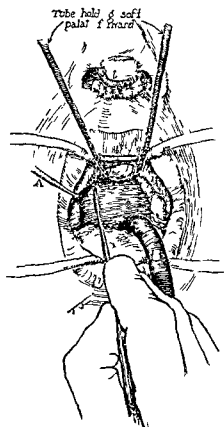
It would seem to be worthy of note that the pressure on the cord is most often not at the site of the fracture but owing to the dislocation of the injured vertebra forward at the junction of the fractured vertebra with the uninjured vertebra below and at times above consequently at operation care should be taken to remove the spines and laminae of the sound vertebrae above and below the fracture.

Three patients with gunshot injury of the spinal cord have been observed. In one the bullet had undoubtedly destroyed the cord at the ninth dorsal vertebra and operation was contra indicated. The other two cases have been reported elsewhere the first by Dr. Hassin and the second by myself.



F 8 B l l t d q u n m d f t t y

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K I S Cl f Ch 7 Ap 35



11 9 1 Location of the bullet between the atlas and the base of the skull. Note the groove on the atlas. The arrow indicates the course of the bullet.

1 Technique of removal of bullet. Case 7. Tube inserted in the nose which protected the septum from pressure, the posterior pillar on the right side being hooked up and drawn forward.

C Sagittal section of the vertebral column showing the position of the bullet.

The first was especially interesting because of the fact that the patient had been operated upon after the accident but the bullet had not been found. He came to me six years after the injury and the removal of the bullet relieved him completely of the intolerable pain which he had suffered for 6 years. The findings are shown in Figures 7 and 8.

In such cases and in those fractures where it is necessary to dissect out the nerves it

will be found advisable to use some type of magnifying glass so that the nerves may be dissected out of the scar tissue with great care. A pair of magnifying spectacles have proved satisfactory to me. In one patient (H. G.) a large pad of fat was transplanted with apparent success in and about the nerves to prevent scar tissue contraction.

CASE 6. M. male, age 6. Cook County Hospital. Dr. Hassin. Shot in 1909. Bullet in spine. Immediately afterward paralysis in both lower extremities. Anesthesia and loss of sphincter control. Loss of sexual control. Cystitis for two

on the left side exactly similar to the one occurring almost daily on the right side. Following this he again passed blood for 4 days as he had done 3 years previously during the only other attack of pain in the left side which had occurred. There had been recent slight fevers, night sweats and 35 pound loss in weight. Urination fairly normal.

Summary. The patient is apparently very ill. Appetite and digestion are poor. He is suffering from frequent attacks of pain under the right costal margin near the spinal column. The attack are occasionally accompanied by chilly sensation but no vomiting. He is accustomed to get up only once at night to void and holds his urine for the normal time during the day. He has no hematuria, no urgency, no difficulty, nor pain on urination. The urine is very cloudy. Sexual desire is absent.

Examination. The patient is a pale, anemic looking man having lost 35 pound in weight. The right kidney is indistinctly palpable, apparently there is some tenderness in that region. On the left side the muscle are tense and there is a palpable mass which reaches two fingers breadth below the umbilicus and to the crest of the ilium, the internal edge is about two fingers breadth to the left of the median line and mass extends up beneath the ribs on the left side and well around into the left loin. It is quite fixed and it is evidently a much enlarged kidney, the surface is somewhat irregular and very tender.

Genitalia. No urethral discharge. Both testicles epididymis cords and groins negative. **Rectal.** Prostate not enlarged slightly indurated moderately irregular and adherent but not markedly changed. The right seminal vesicle is smooth soft elastic not adherent left seminal vesicle negative.

Cystoscopy. The catheter passes with ease and finds 6 cubic centimeters residual urine, the bladder capacity is 180 cubic centimeters on forced distention. The cystoscope meets slight obstruction in the deep urethra. The right ureter lies in a fairly normal looking ridge. The orifice and the bladder around appear quite normal. The urine which comes out at fairly frequent intervals is apparently clear. Starting from the right ureter and passing toward the left the ligamentum interuretericum become progressively more and more pronounced and is finally greatly elevated, the whole left corner of the trigone standing out as a wedge shaped ridge of considerable prominence running into the left ureteral orifice. As the patient expires the corner of the trigone is drawn up into the ureter as he inspires it descends at least one centimeter, but even on deep inspiration the ureteral orifice is still invaginated. As the patient lies on his back breathing this prominent trigonal ridge slides back and forth in the ureteral orifice synchronously with the respiration. The ureteral orifice is held up as a prominent concave fold upon this ridge in front and behind which is quite a deep pouch probably 2 centimeters deep. The ureter is evidently on considerable tension and the whole trigone is drawn

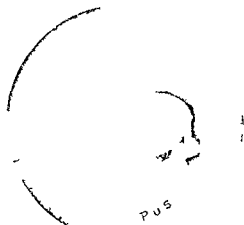


Fig. 1. Ca. No. 380. Cystoscopic view showing left end of interureteral ridge markedly thickened and drawn upward on account of traction by a thickened short neck ureter causing invagination of the corner of the trigone and disappearance of the ureteral orifice. A stream of pus is seen coming from under the crescent shaped fold of mucous membrane although the ureteral orifice is not visible. The thickened ureteral ridge has a to and fro piston rod motion synchronous with respiration.

toward the left as shown in Mr. Broedel's drawing (Fig. 1) which was made from sketches taken by him at cystoscopy. Figure 1 is an ideal reconstruction made by Mr. Broedel from information gained by cystoscopy combined with that obtained by examination of the ureter and kidney during and after operation. The ureteral orifice is evidently quite dilated and contains within its lumen this muscular trigonal ridge. The mucous membrane is everywhere smooth and there is very little injection of the vessels. The bladder itself is fairly normal quite tender. In places there are small petechial red spots but no ulcers and no adherent mucus.

Study of the prostatic orifice shows a slight rounding anteriorly as if there was some contracture of the orifice. The right lateral lobe is not enlarged. The median portion of the prostate is slightly but definitely elevated and is continuous with the hypertrophied trigone and the ridge running into the right ureter. The left lobe of the prostate is not intravesically hypertrophied. No stone and no tumor present. No cellulitis or diverticula present. The bladder is not trabeculated. With the finger in the rectum and cystoscope in the urethra palpation per rectum high up on the left side shows some induration probably in the region of the lower portion of the right ureter but nothing very pronounced. The median portion of the prostate does not seem to be much enlarged. The trigone does not seem to be much thickened.

Urinalysis. The urine is slightly cloudy, amber and albumin present, no sugar. Leucocytes a few red blood corpuscles, no casts, a few cocci in pairs. April 3, 1916.

Ureteral catheterization. It is seen discharging from the left ureter but a catheter could not be

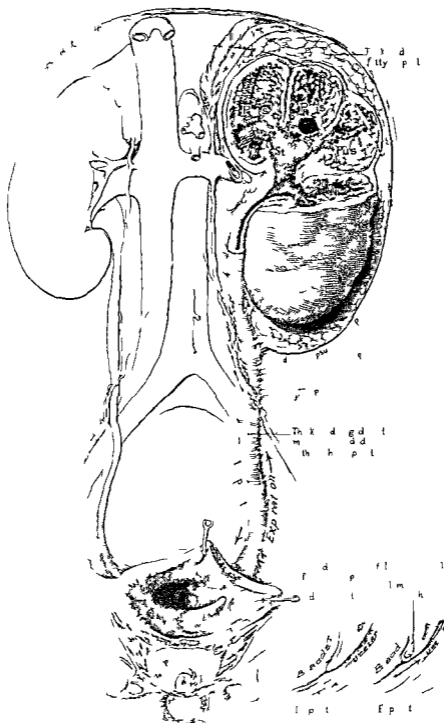




Fig. 3. Case No. 554. Shows remarkable similarity in cystoscopic views in Case No. 554 and

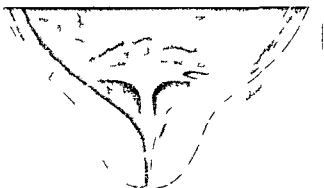


Fig. 4. Case No. 554. Before nephrectomy. Tuberculous contraction without traction on ureteral ridges produces prominent trigone and pouching with underlying tuberculous ulceration behind and on each side of the trigone.

inserted into the left ureter. The right ureter was catheterized but the catheter could be inserted only for a short distance and the cystoscope had to be left in the bladder for time of collection. The urine from the left kidney (if any) was collected transvesically with a catheter.

Right ureter. Phthalein appeared in 4 minutes, 12 per cent in 30 minutes. Microscopically there was no pus or organisms.

Transvesical. Voided 240 cubic centimeters at end of 30 minutes. Phthalein 10 per cent. Some urine from right side may have escaped around ureter catheter into bladder. Microscopic examination shows red blood corpuscle epithelial cells.

Operation by Young April 6, 1914, nephrectomy. Left there was a huge tuberculous kidney which was densely adherent above. The fatty capsule was so adherent that it had to be removed with the kidney. The ureter was markedly indurated and about 1 centimeter in diameter. It was freed and divided 2 or 3 inches below the renal pelvis. The pedicle which was surrounded by very dense adhesions was clamped and tied off with several catgut ligatures. The patient lost very little blood, was in excellent condition and the kidney had not been torn into and no pus escaped. The wound was closed with two sutures (continuous) for the muscle and interrupted for the skin. Two small strips of gauze were brought out at the upper angle of the wound. (Subsequently result showed that drainage tube should have been used as a great deal of fluid accumulated and drainage tube had to be subsequently inserted.) The patient stood the operation well. Condition good.

The patient had a remarkably good convalescence and was discharged from the hospital April 30. There were no complications of any sort. The wound healed nicely.

Cystoscopy. There is no residual urine. The bladder capacity is apparently fairly good. The cystoscope shows in the left half of the bladder an entirely different picture than seen before operation.

The ureter lies in a hypertrophied ridge which is much less prominent than before and there is no urine coming from it. The orifice looks a little more contracted than normal, the margins are a little rough and oedematous but otherwise negative. The surrounding mucous membrane is quite negative. There is no moving of this corner of the trigone on respiration and no invagination and peculiar to and fro movement of the hypertrophied ureteral ridge and corner of the trigone into the ureter is to be seen now. The right ureter looks quite normal. The bladder is negative and apparently normal. The prostate orifice is apparently normal. The urine is clear with a trace of albumin. Microscopic examination shows a few leucocytes and red blood corpuscles, no bacteria. Specific gravity 1014.

October 30, 1914, a letter from Dr. W. T. Turlington, Fremont, N. C. state: Our patient is at work and apparently well. I fully expected he would come back a corpse.

February 15, 1916, A letter from patient states: I am doing all right.

September 16, 1916, another letter from patient states: I have made steady progress. Urination is normal, there is no discomfort in bladder. My general health is good.

May 18, 1917, I have no difficulty of urination. Void urine three or four times a day and once at night. There is no pain, urinary stream medium. General health excellent.

The result obtained in this case is indeed splendid.

CASE 2. No. 5441. J. F. H., age 59, was admitted on November 1916, complaining of cloudy urine and frequency of urination of two years duration. History otherwise unimportant. General physical examination showed nothing of importance. Rectal examination negative.

Cystoscopy. There is a marked distortion of the trigone, the right end of the ureteral ridge being drawn upward and outward and the left ureteral



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membrane while beneath them there was a large area covered only by dirty necrotic granulations which occupied most of the right half of the bladder and extended back on the posterior wall. The mucous membrane surrounding this large ulcerated area presented an irregular undermined edge. The left half of the trigone, ureteral ridge and orifice were fairly normal and the left half of the bladder was not ulcerated. The process was evidently an earlier stage of the process seen in Case 3 in which the ulcerated area has subsequently been covered with mucous membrane — leaving the bridge spanning the area.

With the electrocautery the bridges or strips of mucous membrane were divided at each end and removed. The left half of the trigone was not disturbed with the electrocautery. The median prostatic bar was deeply cauterized suprapubic drainage was provided, partial closure of wound.

Convalescence Excellent recovery from narcosis. The Davis drainage apparatus¹ was applied and was very successful in keeping the patient dry. He was much more comfortable than before operation. On August 4 he still had a suprapubic fistula.

September 16 1916 letter from patient states Epididymitis has developed since operation. Still void about every hour wear a rubber urinal. Urine slow to start and drips afterward. The condition is improving and my general health is good.

May 16 1917 letter states that the patient reports that he has developed a tuberculous epididymitis and recently was subjected to operation — epididymectomy and seminal vesiculectomy. He still has great frequency of urination having to void every few minutes and there is a small urinary perineal fistula present. Catheter find from 2 to 4 ounces residual urine. The general health is as good as it has been for two years.

Pathological report Sections of tissue removed at operation show mucous membrane and muscle. There is extensive cellular infiltration and definite tubercles seen. Diagnosis tuberculosis.

Comment This was a very extensive case of genito urinary tuberculosis which was improved temporarily by operation.

CASE 4 No 3565 Floating trigone removed by division of attachments by fulguration. J. B. age 43 admitted May 10 1913 complaining of frequent difficult urination and hæmaturia. Family history negative for tuberculosis.

Past history negative.

Present illness Eighteen months before admission he began to have frequency of urination. Some time later he had slight pain in the left side recurring occasionally but never severe — only a dull ache in the left kidney region which radiates to the bladder at times. He had never passed a stone nor had he any colic. Nausea or vomiting had never been present. About a year before admission he began having hæmaturia which continued intermittently

until admission at times slightly at others considerable. Six months later he began to have difficulty in urination which gradually increased. He had fever and night sweats for several months.

Summary Urination every half hour day and night clots of blood at end of urination. Urgency quite marked. Stream small. Considerable difficulty in voiding.

Examination Che t negative. The right kidney is not enlarged or tender. The left kidney is enlarged palpable three fingers breadth beneath the costal margin and tender. It moves with respiration and is smooth.

Genitalia negative.

Rectal examination Rectum negative. The left lobe of the prostate is slightly enlarged moderately indurated and adherent but not nodular. The right lobe is about normal in size smooth only slightly firmer than normal. Both seminal vesicles are slightly indurated and adherent. There is moderate induration between the seminal vesicles.

Impression Chronic prostatitis and seminal vesiculitis.

Cystoscopy Catheter finds 40 cubic centimeters of residual urine. The bladder capacity is 80 cubic centimeters. The cystoscope shows a remarkably prominent trigone with the bladder wall on each side and behind depressed like a pouch as shown in Figure 4. The two corners of the trigone form prominent ridges which seem to be drawn upward and outward. The posterior limit of the trigone — ligamentum interuretericum — is also much elevated with a deep pouch behind it. The left ureteral orifice is at the end of the prominent ridge. It is red in color and surrounded by oedematous mucous membrane. The adjacent bladder wall is rough and granular and this condition extends well out to the left. The right ureteral orifice and the right lateral wall of the bladder are similar to the left. The anterior wall of bladder is also irregularly ulcerated and granular. The margin of the prostatic orifice is rough irregular and oedematous and the median portion is continuous with the elevated trigone.

Ureteral catheterization. Considerable difficulty in introducing catheters.

Right shows urine clear amber phthalein appeared in 3 minutes excretion 28 per cent in 15 minutes urea 14 per cent no albumin. Microscopically negative.

Left shows urine cloudy and pale no phthalein excreted no urea. Albumin — a heavy ring pus cell.

Urinalysis Cloudy acid albumin moderate amount no sugar. Microscopic pus cells and tubercle bacilli in large number.

Clinical impression Tuberculosis of left kidney. Tuberculous cystitis with outward traction on ureteral ridges producing prominent trigone. Tuberculous ulceration of pouches on each side of and behind trigone.

May 6 1913 **Operation** by Young **Nephrectomy** left. Dense infiltration of fatty capsule

Visual D E G J A m M A w d p tal f w p
paral D E G J A m M A 6 1 63

encountered The uterus greatly thickened The
wound was closed with drainage

Cooperation as satisfactory and changed July
13, 1955, until present blade improved

Second admission on February 6, 1914, the patient returned complaining of frequency and difficulty of urination. The unilateral swelling healed and he has improved greatly in health and strength but still had urinary retention, with 2-hour night and day, with pain present at the beginning and end of urination. Nephrectomy did not apparently improve vesical symptoms.

Cystos by R id l urin oo cub c centi
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edge... if the br... d... e... m... me... l... ately... beh... nd it... the mucous
memb... ne... be... ag... quit... u... h...

small fo cep through cysto ethroscope by Dr John T Geaghty April 4 1914 cystoscopy shows the left ureter aght in its normal position and just in front of it is een the stump left where the trigonal bridge wa divided by fulguration Just in f on of it s a little place c vered by e udate which is p obably the site of the small attachment of the b idge n the othe s de The stump external to the right ureter s appa ently about 2 millimeters high and or 3 millimeters broad and 3 or 4 millimeters ide The ornce cannot be een o vin to a mass of muc pu in the t region The stump from which the tri onal b idge h s been eparated s vible It s elevated only lightly above the bladder and it i evidently a part of the ureteral dge It does not tand up o p omnently as the st mp of the left side At the p nt of attachment anteriorly the e is a fairly prominent elevation just back f the med n portion of the prostate as shon this is p obably c ns derably magnified The tip co ed ith n uco pu The flo r of the bladder i obscured by mucu pu The prostatic orifice is irregular and the ight late al lobe seems to be a little more undented than normal and the e is a small cleft between it and the med n po tion which is eular and g anula The bladder itself is qu te hyperæmic and gene ally ed and g anular N ston or ulcer i seen

Note — Condit on dist nctly imp oved Urina
t on le s difficult and frequent (patient d scharged)

albumi pre ent pu cells a few bacilli no tubercle bacilli

Aug 14 914 lette fr m patient states I
am st ill ga ning but my bladder bothers me quite a
lot I ur nate q te often a d it hurts me

November 10 1914 another letter says I feel much better but I still ur nat abo t eve y two ho s and ha e to strain to p s the la t urine

Sept mb 16 1906 a letter from physician states
Patient died July 9 1906 of tuberculosis but I
feel that he lived much longer as a result of your
operation

These cases appear to me to represent three progressive stages

1. Elevation of trigone (due to traction of a shortened tuberculous ureter) with pouch formation behind and to the outer side (Cases 1 and 2).

Ulceration of depressed portions of bladder leading to complete undermining of elevated trigone which thus forms a bridge of healthy tissue (mucous membrane and trigonal muscle) across the new formed tuberculous cavity (Case 3)

3 Healing (after nephrectomy) of the subtrigonal tuberculosis leaving the separated trigone as a bridge with fairly healthy mucosa

beneath it (Case 4) It seems very evident that tuberculosis not only may produce marked thickening but also shortening of the ureter This in turn may make traction upon the vesical end of the ureter and trigone leading to invagination of the ureteral margin and elevation of the trigone on that side leaving the bladder depressed around it Tubercle bacilli coming from the ureter naturally find easy lodgment in these vesical pouches while the greatly elevated ureteral ridge and trigone remain uninvolved Ulceration in the pouches leads to undermining of the trigone from the bladder a condition which the anatomists have shown us to be possible as the trigone is separate from and superimposed on the bladder muscle in that region (Fig 6) The movement of the ureter synchronous with respiration (described in Case 1) is surely due to adhesions between the kidney and diaphragm on expiration the diaphragm goes upward and the trigone is drawn upward with it by the adherent kidney and short thickened ureter On inspiration the diaphragm and kidney allow the ureter and trigone to descend The orifice being surrounded by vesical mucosa remains more or less stationary while the trigonal ridge plays back and forth like a piston rod in the invaginated ureteral orifice It is strange that this occurrence has never been noted before

It is interesting to note the changes in micturition which occur as a result of these transformations of the trigone Urination is apparently normal as long as the trigone is not detached and the bladder has not become tuberculous (*Vide Case 1* Trigone much elevated drawn to left by shortened ureter deep pouches behind and externally Micturition normal)

When the trigone becomes pathologically dissected free from the bladder muscle and even after new mucous membrane has formed beneath it obstruction is present (*Vide Case 4* in which 100 cubic centimeters residual urine

was present) This was apparently not much improved by removal of the floating trigone as the patient continued to have residual urine and complained of having to strain to urinate nine months afterward This brings up the question of the part taken by the trigone in the act of urination It seems to me to indicate that one function of the trigone is to pull open the internal sphincter of the bladder I have long held to this view as I have frequently observed during cystoscopy that if violent desire to urinate came on the trigone would contract greatly and the prostatic orifice would open widely the median (posterior) portion being apparently drawn backward by the muscle fibers which run from the trigone down into the posterior urethra and which were seen to contract violently The opening of the internal sphincter during urination will have to be viewed therefore not as an inhibitory action as heretofore but as the result of the contraction of the powerful trigonal muscle which passes in the form of an arc through a weaker muscle of circular shape (the vesical sphincter) and pulls it open when it contracts

CONCLUSIONS

It is abundantly demonstrated by these cases that tuberculosis of the kidney may lead to great shortening of the ureter resulting in traction on and marked elevation of the trigone and invagination of the ureteral ridge into the ureter that tuberculous ulceration may then produce an undermining of this elevated trigone and finally complete separation of trigone from the bladder beneath except at the three corners (where the trigone is continuous with the ureteral muscle above and the urethral muscle below) that after nephrectomy healing of the vesical tuberculosis may leave this trigonal bridge with new mucous membrane beneath it except at the three corners where the bridge is attached and gets its blood supply

THE EFFECT OF DICHLORAMINE-T CHLORINATED EUCALYPTOL SOLUTION ON THE PERITONEUM

B. STANLEY P. REIMANN, M.D., AND JAMES A. H. MAGOUN, M.D., PHILADELPHIA
 F m b D p r t m (P h i l a d e l p h i a) U n i v e r s i t y (P a s i d e n t) L a n k a n a H o s p i t a l

OUR attention has been drawn both by publication and by personal communication to the use of dichloramine T chlorinated eucalyptol solutions in the peritoneum in infections from the appendix fallopian tubes and other organs. Lee and Furness (1) say: Upon removal of the appendix (gangrenous and perforated) the 20 per cent solution has been dropped over all the visibly infected tissue. They follow this by placing a gauze drain saturated with the same strength solution in the cavity and dress the wound daily by applying the 20 per cent oil to the gauze wick and to the edges of the wound. Later when the drain is removed the cavity is filled with 5 per cent oil until granulations close the wound.

On the surgical service of the Lankenau Hospital observations have led to the conclusion that very definite harm can be done by this method of treatment and that contrary to published opinions skin irritation takes place despite careful adherence to the principles of fresh undecomposed solutions minimum dressings avoidance of alcohol water and other substances likely to decompose the solution. Blood and exudate form a solid coagulum in the meshes of the gauze and interfere with drainage. The following brief notes will serve to illustrate these points.

A patient had a retrocaecal appendix abscess opened and the cavity gently mopped with a piece of gauze soaked in the 20 per cent solution. A small piece of selva gauze soaked in the same strength solution was placed in the cavity. The operation was performed in the afternoon and the following morning the patient's temperature reached an excessive height where it remained for several days until the drain which by this time had become as hard and stiff as a lead pencil despite application of oil was removed. Irrigation with Carrel Dakin solution prompt-

ly led to the fall of temperature and general well being of the patient.

A similar experience was gone through by a patient with a perforated gall bladder and localized abscess in that region except that the next morning when high temperature was noticed the drain hard and stiff with clotted blood and exudate was removed. After three days irrigation with Carrel Dakin solution the wound was clean.

A very large appendix abscess cavity in another patient was treated similarly and when the hard stiff clotted blood and exudate covered gauze drain was removed an opening in a loop of bowel against which the gauze had rested was discovered. Subsequent operation was necessary to close the fecal fistula. Skin irritation was very apparent in these and several other cases in which the oil was used. Odor of dressings and pus was not abolished on the contrary it seemed increased. With these observations in mind it was decided to determine the effects of the oil *per se* on the peritoneum and the following experiments were performed and an attempt was made to estimate roughly its protective power in artificial infections of the peritoneum. Two strengths of solution were used 20 per cent and 7 1/2 per cent dichloramine T chlorinated eucalyptol (2). The peritoneal cavities of dogs were opened under aseptic conditions and adhesions and other lesions eliminated by inspection. 5 cubic centimeters of the oil were introduced and the incisions closed. Unfortunately the extremely cold weather at the time led to the development of bronchopneumonia among some of the dogs so that several of the deaths were probably due to this cause. We feel however that the results from the standpoint of our investigation were not altered in the main by this occurrence.

The 20 per cent solution was used in four animals and their abdomens were opened

at different intervals with identical findings. The following is the protocol:

Dog 3. Five cubic centimeters of 20 per cent oil were used. The dog died the second day. Autopsy showed a large amount of free fluid in the abdominal cavity with considerable fibrinous exudate over the intestines at the site of the wound. Many small patches of bronchopneumonia were present.

Dog 3. Five cubic centimeters of 20 per cent oil were used. The dog was very sick for two days but gradually recovered in 3 to 4 days. The abdomen was opened in 14 days. There was distention about 250 cubic centimeters of blood stained fluid escaped. There was a dense hemorrhagicofibrinous exudate with well begun organization matting the intestines to ether in a firm dense mass. This process was more or less limited to the neighborhood of the wound, the remainder of the abdominal cavity showed no solid exudate. No manipulation was done.

Dog 4. Five cubic centimeters of 20 per cent oil were used. The findings were exactly similar to those for Dog 3.

Dog 10. Five cubic centimeters of 20 per cent oil were used. The abdomen was reopened on the ninth day. There were found many well organized fibrinous adhesions in the region of the incision. No free fluid as found. Many small patches of bronchopneumonia were present.

Dog 4 was autopsied 44 days after the introduction of oil and dense fibrinous adhesions had replaced the fibrin and the intestines were matted together in a solid mass. It is very evident from these experiments that the 20 per cent solution caused marked inflammatory reactions with the production of a hemorrhagicofibrinous in one animal a fibrinous peritonitis with later organization and the formation of dense adhesions. It was therefore far from harmless and non irritating to the peritoneum of these dogs.

The protocol of those animals in which the 7½ per cent oil was used follows:

Dog 1. Five cubic centimeters of 7½ per cent oil were introduced. The dog made a good recovery. The abdomen was reopened in 13 days. The abdominal cavity as normal except for small adhesions of omentum to the undersurface of the scar. No oil was detectable.

Dog 2. Five cubic centimeters of a 7½ per cent oil were introduced. The dog made a good recovery with the same findings as in Dog 1.

Dog 6. Five cubic centimeters of 7½ per cent oil were introduced. The dog died in 14 days. Autopsy disclosed large patches of bronchopneumonia. The wound broke down to the muscles. In the neighborhood of the wound there was a small amount of fibrinopurulent exudate among coils of intestine. No trace of oil was detectable.

Dog 7. Reopened in 9 days after the introduction of five cubic centimeters of 7½ per cent oil. There was no trace of exudate adhesions or oil found.

Dog 9. Reopened in 21 days after the introduction of five cubic centimeters of 7½ per cent oil. There was no trace of exudate adhesions or oil found.

Dog 11. Died on the fourth day after the introduction of five cubic centimeters of 7½ per cent oil. Autopsy

disclosed bloody fluid and fibrinous exudate about the site of introduction of the oil. The oil could be detected both by sight and smell and apparently very little had disappeared.

Dog 2. Died on the fourth day after five cubic centimeters of 7½ per cent oil had been introduced into the abdominal cavity. The findings were the same as for Dog 1.

Dog 3. Died on the thirteenth day after the introduction of five cubic centimeters of 7½ per cent oil. Autopsy disclosed a general fibrinopurulent peritonitis with a collection of purulent fluid between the stomach and spleen immediately around the wound hemorrhagic purulent exudate as present. There were patches of bronchopneumonia in both lungs. There was no trace of oil.

Dog 14. Reopened in five days after the introduction of five cubic centimeters of 7½ per cent oil. There were no adhesions or exudate present and no trace of oil.

Dog 15. Reopened in five days after the introduction of five cubic centimeters of 7½ per cent oil. No adhesions and no exudate were found. A few small hemorrhagic spots were present in the omentum under the wound. There was no trace of the oil.

No oil was detected either by sight or smell in any.

Those dogs that died showed definite peritonitis and while bronchopneumonia may have been the cause of death in two of the four in two no gross lesions other than the peritonitis were present. While in the majority no apparent harm to the peritoneum was detected the same hemorrhagicofibrinous exudate as was caused by the 20 per cent solution was called forth in four so that a strong possibility of harm is present in the use of the weaker as well as the stronger solution in the peritoneal cavity. The oil was still present on the fourth day in two of the animals and the chlorine as well as the eucalyptol odor could be plainly detected.

A more difficult problem was to decide if it was of benefit in infection of the peritoneum and if in the presence of infection the oil had the same possibilities of harm. It was approached as follows:

The sigmoid was cut across and anastomosed end to end without clamps. Faces were allowed to contaminate the peritoneum gauze sponges being used to make the soiling a minimum amount localized to the vicinity of the anastomosis. Our experience with the 20 per cent oil led us to discard all thoughts of its use so that when the anastomosis was completed the 7½ per cent solution was dropped over the infected field the sponges were removed and the abdominal wall closed. Two control animals were treated in an exactly similar way without the addition of oil.

The first control animal lived after a stormy convalescence the second died in eight days and a general fibrinopurulent peritonitis with much free fluid was found. Sloughing had occurred at the site of the anastomosis and leakage was considerable. The following is the protocol of those in which oil was used after the anastomosis was completed.

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e d f l
D c D d th th d d y d g e l i b r n
p l t p t t u s t u d
D 4 D d th l th d y Th w l g
m t f f p l t f d d d h l i b r n p l t
p t t u p t
D 9 K u l l d th t t y f i t h d y Th m l
r y k i d v i t h h b d p u l l
Th p p t t d g l l t m d p o
t t t h d v h d p d d r r h a a d m
t l h d d b l d p d l y g w t m
H f i g d t t h t h k l l d th
h l r m A t t p v d e o f g l b b
p r u l t p t t th g i z t n p e t th
b t a g b o t o o b t u m t r p
th p l l l w l l d f f b y d d h Th
t m t g h t

These results with so many variable factors at work must of course be interpreted very liberally if at all but if an antiseptic has the virtue that this oil is said to have the result should have been a sterilization of the area around the anastomosis for the oil was applied on a healthy peritoneum infected by organisms which had not had time at all to obtain a foothold for growth and multiplication. Organisms did grow and multiply however and the result was an ordinary fibrinopurulent general peritonitis.

SUMMARY

The effect of solutions of 7 per cent and 20 per cent dichloramine T chlorinated

eucalyptol on the healthy peritoneum of dogs was investigated. The same strength solutions were used on infected peritoneum to determine if infection would be inhibited or destroyed. Observations from the surgical service on the effect of the 20 per cent oil in the treatment of abscess cavities in the peritoneum are recorded.

CONCLUSION

The 20 per cent solution causes clotting of blood and exudate on gauze and drains and leads to interference with drainage and trauma. In the peritoneum of dogs it causes a violent irritation with a hemorrhagic fibrinous exudation. The same results in the peritoneum of dogs are produced by the 7½ per cent in a certain percentage of cases. Both the 7½ per cent and the 20 per cent solutions are distinctly harmful to the peritoneum; the benefits are none.

O t h n k p d t l f E T R h t t
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W e p p p t f t h t h l h l p f M
D c u t a d H G E l m n

REFERENCES

- LE W E d FURN s W P Th e of d chlo
min T the t t m t f f t d
f t d d A S g Phil 9 S l 4
Th l t u s obtain d f m M J K Thum
h g f t h h p i l p h a m c y h u r d t h
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THE THERAPEUTIC USE OF RADIUM IN GYNECOLOGY¹

By JOHN G. CLARK, M.D., F.A.C.S., PHILADELPHIA

PURPOSE to review briefly the results obtained by radiotherapy in two types of gynecologic cases—first those suffering from profuse or irregular uterine hemorrhages induced by the smaller myomata and the so-called myopathic hemorrhages of benign origin arising from muscular or vascular changes in uteri of women approaching the climacterium; second those comprising the cases of inoperable cancer of the cervix, vagina and external generative organs. We have available for study 100 cases of each class, an unique coincidence which rounds out the two series for easy percentage estimates. To my associate, Dr. F. L. Keene, I am deeply indebted for his careful analyses of the case histories and his accurate tracing of the after results from which our conclusions have been drawn. Realizing that we were entering a new field, we have endeavored to keep free from an overenthusiastic optimism, an error to which one is liable in viewing the hopeless cancer case, which occasionally shows the most astounding improvement and to witness the almost invariable relief of hemorrhagic symptoms in benign cases hitherto subjected to hysterectomy.

THE USE OF RADIUM IN CASES OF BENIGN UTERINE HÆMORRHAGE

In presenting a remedy for the relief of symptoms and cure of cases of chronic metritis and small myoma uteri certain conditions must be fulfilled if it is to serve as a worthy competitor for myomectomy or hysterectomy. Briefly stated, the remedy must effectively cure, must be attended by as small risk or by even fewer hazards than accompany a well executed operation, and must be unattended by immediate or remote complications. Further, the cure must be permanent. To meet the well known ideal statistics of a well ordered series of operations in the hands of a skillful surgeon is no small task for we all have reason to be proud of surgical accomplishments in this type of cases. No one

has taken up the use of radium in the treatment of myopathic or myomatous conditions with a spirit of greater conservatism, indeed with a spirit of skepticism, than we who have had a long series of excellent results accruing from surgical treatment in this field. We first tentatively experimented with radium in patients during their menopausal years, but as our experience has grown we have treated younger individuals because of the successful issue in the climacteric cases.

As the question now stands—but we are still in the experimental stage—we use radium only in very light dosage in the treatment of young women in whom a tumor is not palpable but who are suffering from a depleting flow at the periods. The flow diminishes as a rule to within normal limits but occasionally a permanent menorrhœa results. The latter crisis can and will surely be precipitated by too large a dosage. Further, we do not employ and thus far see no valid reason for discarding an operation when the tumor is massive and by its presence is handicapping the function of adjacent organs by pressure. Large tumors are much more likely to be accompanied by inflammatory lesions and there is always an element of doubt in the diagnosis. In such cases we believe we serve the best professional ends in advising an abdominal operation which permits a complete survey of the entire pathologic field and the removal of such tissues as are necessary to restore our patient to health.

In young women in whom a myomectomy is possible we advise operation for in these cases the uterus may be restored to normal and the ovaries are preserved. Briefly summarized we may say that we apply radium in the following groups of cases:

1. In large dosage, 50 milligrams for 24 hours in women suffering with myopathic hemorrhage or menorrhagia from myoma in women over 40 years of age. In such cases we expect to bring on the menopause and in practically all we are successful.

2 In smaller dosage 5 to 50 milligrams for from 3 to 8 hours in young women with excessive menses incident to myopathic changes in very small myomata in polypoid endometritis and in those cases of irregular and profuse bleeding attributed to excessive functional activity of the ovaries

We do not employ radium—

1 When the tumors are larger than a 5 to 5 month pregnant uterus or

2 In a young woman with a single myoma which may be removed by myomectomy

We have now completed a series of 100 cases all of which are available for statistical study. They are divided as follows:

My	0
(1) m trit	36
(1) 1 d m t t	1
(1) 1 m	—
	∞

This series of 100 cases comprises patients who have been treated for uterine hemorrhage of myomatous or myopathic origin. In no case was the tumor of large size and in each the only symptom was excessive bleeding.

Technique of application. In every case a preliminary curettage was performed and the curetting examined to eliminate the possibility of carcinoma of the fundus. The radium protected by platinum and rubber was inserted to the fundus of the uterus where it remained from eight to thirty hours. In by far the larger number of cases the time of application was twenty-four hours and the amount of radium employed was 50 milligram. The patients were discharged from the hospital in three to five days after operation. In the light of our review of cases we are inclined to reduce the dosage to 50 milligram for twelve instead of twenty-four hours, believing that we will serve an equally satisfactory purpose with possibly fewer menopausal manifestations in some cases.

Results. Nitrous oxid anesthesia is usually employed and the discomfort of the patient is minimal. The shorter stay in the hospital with practically no lingering sequelae is a large factor in hospital economics and favors quick return to working efficiency on the part of the patient. The postoperative con-

valescence is so nearly negative as to make it in no way comparable in danger or possible sequelae to that of even the most ideal abdominal operation. As in the cancer cases nausea and vomiting followed lasting one or two days in only 25 and were absent in 58 instances. In a percentage of these cases the preliminary morphinization in the gas administration may have been responsible for these symptoms. Occasionally there was slight elevation of temperature and in one instance 103 F was reached. Only very occasionally was the convalescence marked by disagreeable symptoms.

We have obtained successful results in all but two cases. Five patients were between 17 and 35 years of age in three of these the profuse menorrhagia has been reduced to a normal flow. There were 5 cases between 25 and 30 years of age, 15 between 30 and 35 years, 10 between 35 and 40 and 61 over 40 years. In all except two cases the periods have entirely ceased for intervals varying from two to nineteen months. Amenorrhoea may immediately follow the application of radium there may be one or at most two scanty period or slight irregular bleeding may occur for a few weeks before the permanent amenorrhoea is established. In several cases a scanty flow recurred after several months but this was again followed by amenorrhoea.

We have been interested in the action of radium in its effects on leucorrhoea. Our results show that in the majority of cases a yellowish discharge follows its application. Rarely a profuse discharge may be present for a few weeks but is not permanent. Nineteen of our patients gave a history of profuse leucorrhoea preceding radiation which was entirely relieved by the treatment. In the relief of this symptom we have been agreeably surprised since it seemed logical to assume that the changes produced in the endometrium and uterine blood vessels might lead to a permanent and troublesome discharge.

Abdominal or pelvic pain has followed in 30 cases immediately after radiation lasting however but a day or two. It is of interest to note that varying symptoms of the menopausal pause between slight and severe have

SUMMARY OF RESULTS FROM THE USE OF
RADIUM IN MYOPATHIC HÆMORRHAGE

Pathologic conditions	
Myoma	60
Chronic metritis	36
Polypoid endometritis	3
Cervical stump	1
	—
	100
Age of patients	
17-20	2
20-25	3
25-30	5
30-35	13
35-40	16
40-45	28
45-50	23
50-55	0
	—
	100
Influence on periods	
Immediate cessation	40
One period	8
Two or more periods	23
Return to normal and regular	15
No relief	
Not stated	
	—
	100
Return of bleeding	
None	4
To normal after months of cessation	4
Once or twice only then amenorrhœa	1
Profuse	1

developed in 53 cases and have been absent in 37.

Only two unsuccessful results occurred. In the first, a case of chronic pelvic inflammatory disease, the patient's chief complaint was excessive and irregular menstruation. This case was diagnosed incorrectly as one of myopathic hemorrhage, and as a result of the operative manipulation there was a recurrence of the old process, and two days after the application symptoms of acute pelvic peritonitis developed. An abdominal operation a few weeks later revealed an old infection with a superadded acute process.

In a second case the radium failed completely after two 50 milligram applications of 24 hours each in the presence of multiple myomata. When the uterus was removed, no visible effects of the radium upon the tumors or the ovaries could be detected either macroscopically or microscopically.

Conclusions. Radium is the treatment of choice in all cases of small uncomplicated myomata in which the only symptom is hæmor-

HISTORY OF PATIENT AFTER
APPLICATION OF RADIUM

Leucorrhœa	
None	44
Persisted with complete cessation	19
Slight	26
Cured by radium	5
Not stated	6
	—
	100
Pain	
Absent	64
Present	30
Not stated	6
	—
	100
Nausea and vomiting	
None	58
Present	25
Not stated	17
	—
	100
Complications	
Persistent (pyometra)	1
None	97
Subsequent operation necessary	2
	—
	100
Menopausal symptoms (according to age)	
7-10	1
20-25	1
30	1
30-35	8
35-40	8
40-45	9
45-50	10
50-55	5
	—
	53
None	37
Not stated	10
	—
	100

rhage. In these as well as in cases of myopathic hemorrhage almost 100 per cent cure may be expected. Sufficient dosage will produce complete and permanent amenorrhœa. In young women radium should be used with the greatest caution, since its application may be followed by a premature menopause. If other measures have failed in women under 30 years of age, radium may be employed, but in small dosage. Irregular bleeding due to pelvic inflammatory disease, tumors of large size or tumors of any size complicated by disease of the adnexa or surrounding structures as well as single myomata in young women are to be treated by appropriate operation and not by the application of radium. In no case of uterine bleeding should

radium be used without a preliminary curettage and microscopic examination of the curettings by a competent pathologist. Radium is applied at the same sitting as the curettage. In properly selected cases the immediate convalescence is uneventful and restoration to health is complete. Pelvic pain rarely occurs and as a rule is of but a few days' duration. In the exceptional case leucorrhea follows the application of radium but this is not permanent. Not infrequently radium has cured or diminished a discharge which was present before the remedy was applied.

THE USE OF RADIUM IN CANCER OF THE FEMALE GENITATIVE ORGANS

The lapse of time since we began the use of radium for cancer of the female genito-urinary system does not permit us as yet to regard it as an approved curative remedy for our period of observation has extended

over only three years and the five year test has not been passed. While therefore we must hold in abeyance any forecast as to ultimate results, our series of 100 cases nevertheless justifies us in estimating with great assurance the excellent palliative effects of radium. Before the advent of radium in the treatment of cancer of the cervix we were constantly passing in clinical review large numbers of cases among which only the occasional one was amenable to surgical measures; the others upon being classed as inoperable dropped into the hopeless discard and frequently did not appear even in our card indexes. A very few only of the latter class ever reached the hospital ward for beds could not be utilized for this hopeless class of patients. Because of this casual treatment of these patients we did not realize the extraordinarily large disproportion between the operable and inoperable cases and in former years I offered my small series of radical operations for cervical cancer with a puzzled query for if cancer was so frequent as was constantly asserted why was not a larger number of operable cases being admitted to our ward.

In view of our more recent experience the answer comes with overwhelming

force and a surgical optimism never enthusiastic is now reduced to even a lower degree in the face of these discouraging figures for while by the more radical method we operated upon only about 60 cases in 10 years or an average of about six annually we now estimate that we were turning away during the same decade at least 300 as hopeless. A basis for this assertion is laid upon the statement that during the last three years we have refused no patient regardless of the extent of the growth and giving all the possible benefits of radium, 100 having been admitted to the hospital. Combined operative statistics show that even in the selected cases for a radical hysterectomy the primary surgical mortality will seldom fall below 10 per cent; that the disabling sequelæ are numerous and serious and that in the end under average skill at least 66 2/3 per cent will die from a recurrence. We have therefore no reason to boast of epoch making strides in the surgery of cancer of the uterus. Because this minimum salvage is the best that has been obtained by any other means of treatment we still strongly adhere to the dictum that when the case is within surgical bounds it should be treated by radical surgical measures. However the remarkable palliative results following radiation in cases of inoperable cancer of the cervix have modified our viewpoint as to the cases which fall within the elective surgical class for our former rule was when in doubt as to the extent of the growth operate but we now reverse the policy and in these cases we employ radium. Under this restrictive policy our percentage of operative cases has shrunk but we trust that under this conservative elective policy better curative results from a radical hysterectomy will be secured in the future. We justify this conservative attitude by the assertion that in 100 inoperable cases treated locally healing has occurred in 5 per cent. This does not mean however that all of these 5 patients are alive for several are dead of metastasis but without return of the local cervical process primarily destroyed by the radium. Even though the patient died from the secondary invasion this is a remarkable showing as to palliative results exceeding in our experience

all previous remedies and we trust that several in our service will survive the five year test.

One of the terrifying symptoms for the patient and her family is the more or less massive vaginal hemorrhages. Of our 100 cases 60 were completely relieved of this symptom. There was a recurrence of hemorrhage in 10 and in only 4 was it uninfluenced. Vaginal discharge other than hemorrhage was checked in 51 uninfluenced in 15. Of those suffering pain 23 were relieved and 14 were not relieved. In some cases the relief of pain was only temporary varying from a few days to a month or more.

A few surgeons have advocated the use of radium preliminary to hysterectomy. From this view we are radical dissenters for it hardly appears conceivable that a remedy which works effectively for at least 2 centimeters from its point of application can be improved upon by a surgeon's knife limited by such insuperable barriers as the bladder in front the rectum posteriorly and the ureters and pelvic vessels laterally. We therefore adhere strictly to one rule namely never to attempt an operation on any case that has been healed locally by radium. It appears to us a most unwise surgical policy to subject a patient to the hazards of a radical operation rendered more dangerous by the dense cicatricial tissue which forms in the wake of a successful radium application in what we believe to be a fatuous attempt to secure still more lasting results. Indeed we are inclined to the view that under such manipulation nests of degenerating cancer cells enclosed in a sarcophagus of dense connective tissue may actually be liberated and thus render abortive an otherwise good palliative result.

Radium as is shown in our series of cases is by no means an infallible panacea for cancer. There is no way of determining which case will be benefited by its use. There is beyond doubt a certain percentage as estimated by our observation in which cancerous growths are not retarded by radiotherapy indeed in an occasional case it would appear that there is a positive acceleration of new growth. That many cases show an astounding improvement with local disappearance of the

ulceration cannot be gainsaid. In our series several instances occurred in which the results achieved were so remarkable as to be almost incredible. Doubtless in some of these cases the fire is but smouldering and will break out sooner or later with renewed violence as several of our cases have proved but upon the whole this treatment yields to day the least highly encouraging palliative results and we trust that permanent results will follow in a definite percentage of other wise hopeless cases.

In the discussion of cancer cases the question of hospital economics must not be lost sight of. The length of stay in the hospital following a radical operation will average at least three weeks whereas after the application of radium not more than three days will be required. When complications arise after radical operations they are usually serious entailing much suffering. Such patients on returning home are likely to remain semi-invalids for several weeks or months and when as is frequently the case there is a rapid continuation of the disease they become a heavy burden to a poor family. In the comparison of statistics this difference between the two classes of patients is greatly in favor of those treated by radium a fact that tends to incline us strongly to the use of radium in border line cases which we formerly subjected to a radical operation.

Removal of the uterus in cases of cancer of the fundus has yielded such good results that we do not feel justified in taking any chances with radium even in the border line suspects except in those where there is a serious surgical contra indication. In our series of 100 cases only four of carcinoma of the fundus were thus treated. *Our surgical attitudes toward the cervical and fundal growths are diametrically opposite. In border line cases of cancer of the cervix we invariably employ radium. In advanced cases of cancer of the fundus we invariably perform a hysterectomy.*

A pessimistic view dominates our outlook in the surgical treatment of the cervical growths if the pathologic process is at all advanced whereas fundal growths may be viewed with a cheerful optimism even when the cancerous process is extensive. As a palliative agent

RADIUM IN INOPERABLE CANCER OF CERVIX VAGINA AND URETHRA—SUMMARY

Diagnosis
C m f
C m f l
C m f a
I t
L th
Ch i th hom

Ag f t t

o

o

3 4

40-4

45 5

o

5

o

H t t t t t t t t t t f d m—

H m l l

C m l t l l

P

U f l

N t t t l

f l a

(l) k d

l f l

N t t t d

I

R l l

N t l l

N t t t l

I t l a

l t k l

l l l g

N f t g th

H t l k th

Imm i t t d

St l l t l—

l t t t t d

l t t p t

RESULTS

D
4 4 m th
6 4 m th
6 4 m th
8 4 m th
o 4 m th
4 4 m th
4 4 m th
6 4 m th
8 4 m th
6 4 m th
8 4 m th

6 4 m nth
4 4 m ths
8 m th
o 4 m nth
4 4 m nth
4 4 m th
8 m th
t m ths
t 4 m th
8 4 m th

D d f d y f t l
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3 h p t l t m h t t l

we may assert with full assurance that we have never obtained results with any other method that have even approached in beneficence those secured by radiotherapy. The treatment is simple and entails no distress to the patient and the result in checking hæmorrhage are immediate and in a very large number of cases this symptom never returns even in the fatal cases. Because of the well nigh miraculous action of radium in the occasional case there is danger of unbridled optimism and no one should let the occasional astounding result cloud his vision when it comes to a judicious consideration as to the best procedure in a large series of cases.

CONCLUSIONS

1. As a palliative remedy radium in the treatment par excellence in inoperable cases of cancer of the cervix.

2. In border line cases in which formerly we accepted the grave risks of an operation in the hope of eradicating the disease we now employ radium but in the certainly operable class we still advocate a radical operation.

3. In cancer of the fundus even when far advanced we perform a hysterectomy resorting to radiotherapy only in the face of grave operative contra indications.

4. As yet we claim no cures but based upon the observation of a considerable number of inoperable cases which have remained locally healed from one to three years we venture the hope that the quinquennial test will find several survivors.

In this brief summary we have attempted to give a fair and unbiased statement of the benefits limitation and dangers of radiotherapy in gynecology. Our conclusion of today may be considerably changed by our experience of tomorrow for this therapeutic endeavor is still in the period of probation but our experience thus far proves with great assurance that the benefits of radiation are so great that no well ordered clinic can do the best work without it. In our experience 100 milligrams have been sufficient to serve a most satisfactory purpose in gynecologic practice.

RADIUM IN UTERINE CANCER¹

BY HAROLD BAILEY M.D. I.A.C.S. NEW YORK

RADIUM has proved to be of great value in the treatment of uterine cancer of the inoperable type. It not only ameliorates the symptoms but in many cases the entire process comes to a standstill with few or no clinical evidences of the disease remaining. Those who have been applying the substance with the usual technique scarcely doubt that it causes a disappearance of the tumor tissue which is in close proximity to the applicator. Notwithstanding he would be an unwise man who would advise its use in the operable case even when the cancer involves but one cervical lip and appears to be only a local disease. Why is this so? The answer is that the effect of the rays is not under the control of the user. Small doses of the radium may be safe but they do not reach the outposts of the disease on the other hand large doses may destroy all of the cancer but much damage is also done to the normal tissues.

Reports from various clinics show that the inoperable cases have a rate of cure of 15 to 25 per cent. The inference is that treated by the same technique the operable cases would show a rate of cure that would be very high. Howard Kelly has prophesied that eventually the cure of the operable class will be raised to 75 per cent by radium and operation.

I believe that it is only a question of improvement in technique so that the entire pelvis may be radiated effectively without damage to the normal tissues when all operable cases of cancer of the cervix will be treated with radium. At present even pre-operative treatment is not justified because of the difficulties in removing the organ from the inflamed pelvis.

The justification for the use of radium in uterine cancer at present lies not in the fact that a certain proportion of the cases will be cured but rather that in inoperable cancer the patient has but a short time to live and the damage to the normal tissues is but an inci-

dent and may be discounted in the attempt to obtain a permanent retrogression.

After ten years the last four very active ones in which experience has been gained in the use of radium in deep seated work it is time that the technique be so standardized that the treatment of cervical cancers may be conducted without injury to the normal tissue or the hollow viscera immediately surrounding the affected part.

Variation in the dosage as advised by the leaders of the different clinics extends from 50 milligrams of the salt to 1000 or even 1500 millicuries of the emanation. The length of time of the application receives so little consideration that it usually depends on convenience that of the half or full day being usually favored. Inside the body—the vagina or the uterus—distance is seldom taken into account. The more or less mythical extraordinary resistance of the vaginal mucous membrane is relied upon and unknown or forgotten are the distance factors of safety demonstrated duly by those who use radium upon the surface of the body.

Sometimes week after week reapplication of the radium is made to the very same area that was originally treated in the hope that in some miraculous manner the rays will exert their curative influence at a farther distance and yet do no harm to the nearby tissue. With the attention riveted to the local lesion it has not occurred to many that there are paths for directing the rays to the affected part other than through the vagina. Little heed was paid to cross raying until the treatment of fibroids made it necessary.

The thickness of the metal filter of lead or platinum is usually standard at 1 or 2 millimeters in all directions. That the side of the filter away from the lesion might be considerably thicker has not been made an important item in the technique except by Kelly and Burnam who use the lead cup or layer of beaten gold to cover the back of the capsule.

Furthermore the treatment of the far

advanced postoperative and inoperable cases where the vaginal walls and the rectum or the bladder or both are involved should cease. It is not only a waste of time but it actually does harm to the patient in making her remaining days more painful. Merely palliative treatment of this class is spoken of but it is not evident in what the palliation lies unless it is the lessening of the discharge which relief it must be very temporary.

Until the faults (of which perhaps none of us has been guiltless) are remedied radium is hardly all a help if usefulness except in the peritoneal cancer.

RADIUM TREATMENT OF UTERINE CANCER AT THE MEMORIAL HOSPITAL

At the Memorial Hospital, New York, there have been 110 cases of uterine cancer under radium treatment during a period of two and a half years from January 1915 to May 1, 1917. These cases have been on the service of Dr. George H. Mallett, to whom I am indebted for many courtesies.

Owing to the beneficence of Dr. James Douglas, the hospital has had a steadily increasing supply of radium so that it now possesses over 5 grams.

The hospital has a Physical Department formerly under the charge of Dr. George Bozworth and now under that of Mr. G. Failla, and I wish here to express my appreciation for their diligence and patience in preparing the applicators and for the many useful suggestions that they have made.

All of the work has been with the emanation. It permits of a more accurate application because of the small size of the containers and it represents the full ray strength of the metal. A millicurie of the emanation is that amount of the gas that is in equilibrium with a milligram of the metal. As the salts that are so often used are approximately 50 per cent strength the confusion concerning the dosage would be lessened if all reporters would speak of it in the terms of the metal.

In 1915 there were 50 cases treated the same number in 1916 and the remaining 20 have been under treatment this year. In the first part of the work there was no selection of the case but since the latter part of

1916 I have been quite particular in this regard. In the entire series there were three operable cases which were treated with radium alone but in each of these cases there were physical or psychological reasons which made operation impossible. Following the treatment there were 3 cases operated on by others each time with our concurrence or advice and in all three the specimens were obtained. In 1915 and the early part of 1916 there were 26 patients who had the Mercy operation previous to the application of the radium. A hysterectomy was done on one case of cancer of the body with extensive involvement of the uterine wall.

Technique. In 1907 Dominici devised the method of using hard radiations—the ultra penetrating rays—and cutting off the softer β rays by filters of lead. His followers, Wickham and especially Cheron, led the way in the treatment of uterine cancer by this method. At first amounts of 50 to 100 milligrams of the salt RaBr were used but later Cheron arrived at the conclusion that the massive dose produced the best results and warned against the use of the small dose of less than 50 milligrams.

At the Memorial Hospital in 1915 one technique was continued throughout the year. It was patterned after the French method and differed from it only in the time length of the applications. The applicators were similar to the ones so often shown—a small lead capsule about the diameter of a lead pencil and about 2.5 centimeters long, the wall being everywhere 2 millimeters thick, a flat millimeters thick lead applicator 2.5 centimeters square for use in the vagina and a probe applicator of silver for use within the uterus. Besides the vaginal and uterine treatments applications were made within the rectum by placing the lead capsule within the T cross piece of a rubber tube similar to the ordinary vaginal drainage tube. After insertion into the rectum folded the arms of the T would be lifted and serve to hold the applicator in the position desired. All of the applicators when used were covered with 2 millimeters of rubber except the silver intra-uterine probe which was seldom so covered as it was thought at the time that the

uterine muscle would act as a sufficient filter for the secondary rays

During the first nine months of 1915 many of the cases about 30 in all were given in addition to the radium treatments with the Coolidge tube

At the end of the first year the number of cases classed as in good condition amounted to 26 per cent this figure changing to 10 per cent at the end of 1916 Still the results of the first year were very unsatisfactory for a great many cases had bladder or rectal irritation or both and a very considerable number of them developed with the progress of the disease either bladder or rectal fistule

Technique of 1916 Two changes were made in the technique at the beginning of the second year which still remain as standard

First the metal filter was changed from lead to platinum The latter metal is a much better filter because of its density and the secondary rays are not as hard as those from lead consequently the irritation of the surrounding organs is not as great The same change was made in many other clinics but some covered the lead with brass or even used three metals to overcome this secondary ray effect

Second with the small capsule no application was made without having it inserted into the cervix or the uterus In other words the capsule was not placed in the vault of the vagina against the tumor and whereas formerly the vagina was loosely packed with gauze in order to hold the radium in place from this time on the gauze was applied with the purpose of giving distance between the applicator and the vaginal vault The idea of obtaining distance led perforce to the giving up of the rectal applications

These precautions made a striking difference in the comfort of the patients for the proctitis and the cystitis cases became fewer in number and the total of those developing fistule in the course of their disease dropped to 6 per cent for the year notwithstanding that the total average dose for each patient was much larger

A trial was made of steel needles containing emanation for insertion into those tumors that grew out into the vagina but burns from the

β rays observed in one or two cases led to a discontinuance of this method

Development of the mercury filter apparatus not in use Early in the second year having desisted in the treatment of cross firing from the rectum and vagina I was forced to find a new method of filtering the radium so that it might again be undertaken The repeated treatments week after week with the radium applicator about in the same place in the cervix resulted in a local necrosis of that portion which after the first treatment was presumably free of active cancer cells Knowing that the diffusion into the tumor of a lethal dose was not enhanced to any great extent by reapplication and following the suggestion of Kelly and Burnam in their use of the larger doses surrounded by an extra filter in the shape of their lead cup I constructed a solid lead globe with a diameter of 3.5 centimeters One pole was sawed off and a set in made to hold the platinum capsules This was applied with the capsules holding 1000 millicuries of the emanation nine times during the months of March April and May 1916 There were no burns but there was considerable irritation of the neighboring parts As the ionization through centimeters of lead is less than 5 per cent of the original amount it would seem that possibly the irritative action was due to secondary rays

As a filter for the rays mercury is the best of all the metals For all substances the coefficient of absorption is in relation to the density I or the lighter substances as aluminum and iron the increase of the absorption through varying depths of the material is almost exponential but with the heavier substances as lead and mercury this is not so With these latter materials every millimeter of increase of thickness leads to decided changes in the absorption coefficient The variation with mercury is much greater than with lead and with penetration through a thickness of one centimeter or over the absorption is about one third greater than with lead

With these facts at hand an applicator was then devised of about the same shape as the other but consisting of a thin cup or capsule of iron Into this was poured mercury to a

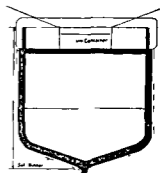
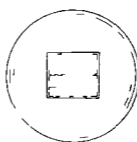
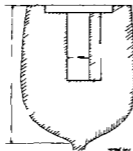
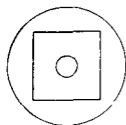


Fig. 1. At left top. Fig. 2. At right top. Fig. 3. At left bottom.

Fig. 4. At left top. Fig. 5. At right top.

thickness of centimeters. The top of this apparatus was a receptacle with its sides protected by 6 millimeters of lead to hold the platinum tubes and over this was a hard rubber cap. Rubber tubing to the thickness of or 3 millimeters was used to cover the iron. At the lower end was a flexible wire for directing the apparatus in the Kelly and Burnham cup. Lately another similar apparatus has been made with the side wall of the iron capsule extending 1 centimeter above the radium. The thickness of the mercury at the projecting end is one centimeter and behind the radium there are 2 centimeters. The Physical Department has roughly measured the ionization of bare radium through 1 centimeter of mercury and found it to be in the neighborhood of 1 per cent and through centimeters to be 0.3 per cent. I hope later with the help of Mr. Laula and his staff to make accurate measurement of the ionization through varying thicknesses of mercury and as nearly as possible under the same conditions as would be met in the clinical work so that if possible a smaller but equally effective machine may be constructed.

In using the mercury bomb two objects are to be accomplished: first to cross fire with a piece of radium within the cervix and second to carry the radiation for a considerable distance into the pelvis. Therefore a platinum tube of 100 millicuries of the emanation is placed within the cervical opening and left for six hours. At the same time the apparatus is inserted into the vagina and directed toward the lesion in the cervix and with the hard rubber cap pressed against the ulcerated

tion. It is kept in position for two hours by packing a strip of gauze between it and the vaginal wall if the vagina is roomy and by fastening the wire stem to the thigh by adhesive plaster. It is necessary to have the patient on the examining table throughout the treatment so that the apparatus will not sag and lose its proper direction. The comfort of the patient is aided by placing a sandbag beneath the knees.

At the next vaginal application usually the following week the bomb is directed toward the right parametrium for one hour and held in place by strapping the stem with adhesive to the abducted and slightly flexed thigh of the opposite side. The left parametrium is then treated in a similar manner for one hour. The weight of the apparatus about 1 ounce permits of its use for only two hour period.

By this method a lethal dose for the average uterine cancer cells is delivered into the pelvis for a distance of several centimeters. If as histological examinations seem to prove an amount of radium equal to 100 millicuries produces a lethal influence on tumor cells at a distance of 3 centimeters then as the strength of the radiation is inversely proportional to the square of the distance 600 millicuries would deliver a similar dose to the cells at a distance of 7.3 centimeters according to the following formula:

$$\frac{D}{d^2} = \frac{D_1}{d_1^2} \quad \frac{100}{3^2} = \frac{600}{d^2} \quad d^2 = \frac{600 \times 9}{100} \quad d = \sqrt{54} = 7.3$$

In addition to the vaginal treatments the lower part of the abdomen is divided into

TABLE I—IADIUM DOSAGE

N f			
N f t t m t			l l l l
A g t l l	h m ll h m ll	so ll h ll	l l f M m ll h
A g t l l	h m ll	h m ll	h m ll
A l g t l d l m t	N f t t l t t		A m h m ll
A g t l d	A t t l d N		h m ll

three segments one over the symphysis and one at either side just above Poupirt's ligament. Applications are made to these areas with the same mass of emanation as is used in the vagina. Instead of the usual radium pick of many small doses spread over a considerable area at centimeters distance the radium is placed in one mass at 4 centimeters and is left in place for six hours. It was found convenient to use a block of wood 4 centimeters thick to place the radium on and the sides and cover of this block were lined with 3 millimeters of lead. This dose so used is just on the border line of the erythema dose as I have demonstrated to my satisfaction. The rays at the distance of 4 centimeters are more homogenous and thus the skin dose approximates that received deep in the pelvis. These abdominal treatments may be given the same 4 hour period as the first vaginal. In cases in which there is induration in the back of the pelvis the same mass is also applied over the sacrum.

An example of recording an actual case under treatment is shown in table below.

Abd m l T m t	Rght 3000 m h	C t 3000 m h	I ft 3000 m h
N s l t m t	6 m h B ml ppl t	54 B ml t l 400	600 B ml
S l m	N	100 m h	

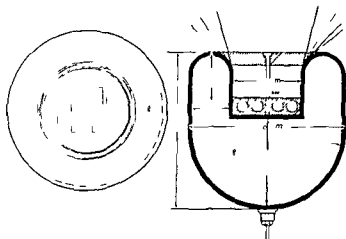


Fig 3 Container under construction. At left top view at right section.

In 21 women there have been 60 applications of the mercury apparatus between December 1916 and May of this year. In the 6 women there have been only three cases of rectal irritation and one of these patients is apparently free from cancer and another is greatly improved. It is a little early to pass judgment as regards the irritation but the local slough so commonly seen in the old method seemed to be avoided.

In examining Table I it will be seen that the average dose of 1915 was small and it will be remembered that the filtering was almost entirely of lead. During the second year the actual amount of the emanation used at each treatment was doubled and the time of application kept nearly as long. As far as we have gone this year the principle of cross raying has been uppermost in our minds. While the radium amount has been many times larger the time has been very much shortened so that as far as the various methods may be compared the average total dose from the standpoint of millicurie hours has been greatly reduced.

The abdominal treatments are accessory applications which may be compared with the roentgen ray treatments of 1915. No one can read the history of Bumm's cases which were treated with X ray alone without drawing the conclusion that there is a future for this treatment of uterine cancer. The combined treatments with X ray and radium is logical and the adopted technique in many clinics. The I rays from a Coolidge tube per unit of

slightly better than where previous treatment had been instituted. Twenty one per cent of this class showed marked improvement with the possibility of remaining free from cancer.

When a period of two years passes a fairly good estimate may be made as to ultimate results. It would seem that not over 15 per cent of my cases lived to that period but in these the probabilities of a complete retrogression are great. On the other hand over 80 per cent lived through the first 6 months and it is very difficult to sift the good from the bad for nearly all show local improvement.

It is not easy to formulate any conclusions as regards the actual treatments but I am convinced that the inoperable cases do better without the Percy operation. I believe that

the initial dose of radium should be high and that it should seldom be repeated for the same reason. Cross firing should be made use of from within and from the surface of the body. The filters on the sides and back of the applicators used in the vagina should be so effective that no harmful effect can result to the surrounding tissues and as mercury reduces the ionization more than any other metal its use for this purpose is advisable. Finally the treatment should be completed as soon as possible so that the time of a second application will not coincide with the irritative effects of the first.

I am indebted to Dr. William S. Stone and rector of the hospital for his friendly consideration of my work and for his contribution of the findings as presented in this paper.

AN EXPERIMENTAL AND CLINICAL STUDY OF KIDNEY AND URETERAL STONES WITH A CYSTOSCOPIC METHOD FOR THEIR REMOVAL

BY VICTOR D. LESPINASSE, M.D., F.A.C.S., CHICAGO
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TO discuss intelligently the problem of removal of ureteral stones we must study closely the mechanics of the passage of stones through the ureter without the aid of surgical art.

Ureteral stones are rarely formed in the ureter being usually formed in the pelvis of the kidney whereupon engaging in the physiologically dilated kidney end of the ureter and being arrested there they are propelled downward into the ureteral lumen by two forces namely the normal ureteral peristalsis and the pressure of the urine the greater force being the ureteral peristalsis.

The pathological stone as it passes wedges its way through the ureter causing a dilatation of that tube. This dilatation is at first the size of the stone but the widening of the lumen of the section of the ureter above the pathological stone gradually becomes much greater than the diameter of the stone because of the back pressure of the urine. This dilatation also involves the kidney pelvis and

calyces and is rapid or slow depending upon the degree of obstruction to urinary flow occasioned by the stone and also measured by the length of time the stone remains in the ureter. This dilatation produced by the back pressure of the urine becomes painful only when the stone completely obturates the ureter.

That section of the ureter between the pathological stone and the bladder is normal and undilated and being of a lesser diameter resists the passage of the stone. Here then lies our problem to expand this segment of the ureter painlessly and sufficiently so that the stone can pass into the bladder. My method accomplishes a painless dilatation of the ureter the dilatation is perfectly controlled and the stones must descend after which the ureter gradually returns to normal size.

The pain caused by a stone passing through the ureter is due to three principal factors (1) the irregular peristalsis of the ureter



Fig. 3 (at left) Ureteral dilator apparatus completely assembled. It should be to pass it into the ureter.

Fig. 4 The perforated artificial stone projecting from the dilator. It is introduced into the ureter after the dilator is in position.

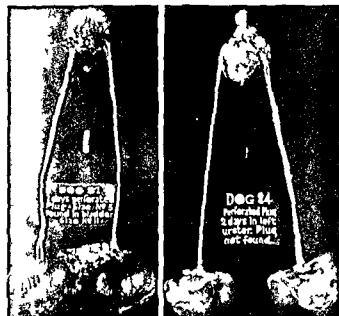


Fig. 5 Do. 82 Perforated artificial stone placed in the vesical orifice of the ureter. Dog killed two days after perforated artificial stone was inserted. Perforated artificial stone found free in the bladder consequently the effect had been reduced upon the ureter in less than two days. Note the equality in size of the two kidneys. Note also the enlargement of the left ureter. The small object in the center is the artificial perforated stone that was used.

Fig. 6 Do. 84 Note the enormous dilatation of the ureter and the normal size of the kidney.

dilatation commences immediately above the perforated artificial stone and gradually extends up the ureter and only involving the kidney when allowed to remain for a relatively long time. When this lumbaria or artificial perforated stone becomes wet the diameter of the perforation increases in direct ratio as the overall diameter of the artificial stone or cork. The artificial stones made of lumbaria when wet will expand as follows: Nos. 5 to Nos. 11 and 12 and No. 9 to about No. 25 French size.

The stabilizer is a ureteral catheter with the eye end cut off. The apparatus is assembled by passing the wire of the introducer through the perforation in the artificial stone then further passing the wire through the stabilizer so adjusting the parts that the cylinder of the introducer shall be in contact with one end of the perforated artificial stone and the stabilizer with the other end of the artificial stone. The stabilizer is held in place by a set screw on the wire of the introducer.

The apparatus when assembled forms one continuous slender instrument.

Sterilization. The introducer may be boiled the perforated artificial stones or corks may be sterilized by soaking them in formalin solution. The formalin is removed by washing in sterile water. The perforated artificial stones should be dried under sterile conditions and when thoroughly dried in

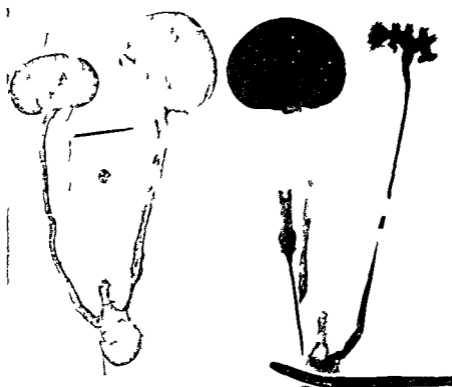
this way they are ready for use. The stabilizer is sterilized the same as any ureteral catheter.

Presuming that a pathological stone may have wedged its way a given distance through the ureter the following procedure will be noted.

When the perforated artificial stone has been placed in the vesicle end of the ureter the dilatation of the ureter begins immediately just above the perforated artificial stone or cork and the dilatation gradually extends further and further upward toward the pathological stone.

When this widening process has reached the pathological stone and the lumen of the ureter is of sufficient diameter to loosen the pathological stone this stone will descend to the artificial stone whereupon the artificial stone is withdrawn and soon the pathological stone will drop into the bladder (Fig. 2).

Injuries to the kidney. The presence of a stone in the kidney or ureter indicates injury to these structures the extent of this injury

[illegible]

depending upon the character and hap-
of the tone and the length of time the tone
has been in the kidney or ureter.

My method of treatment can in no way increase the injury to the kidney because this principle of dilating the wall of the ureter can be fully controlled in length to extend to the kidney but by proper application and control of the perforated artificial tube to reach the dilatation need extend only far as one may wish to dilate the ureteral wall in fact or similarly the dilating tube would act only between the artificial tube and the pathologic tube or if the pathologic tube may not yet have entered the ureter but is still free in the kidney pelvis a dilatation of the

ureter and also a dilatation of the kidney pelvis may be produced which will allow the stone to engage in and pass down the ureter much more readily. The dilatation from the bladder effected by the forces of dilatation is entirely at the will of the operator; he may increase the dilatation at his discretion by regulating the time that the artificial perforated stone or cork is left in place at the ureterovesical orifice.

Injuries to the ureter. The dilatation of the ureter produced by the perforated *artificial* tone or cork will disappear after the apparatus is removed from the ureter. The local effect upon the walls of the ureter is slight readily being upon removal of the apparatus

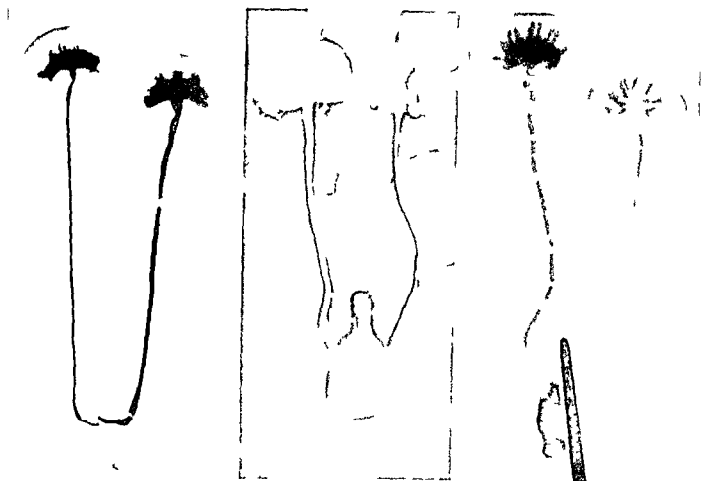


Fig 9

Fig 10

Fig 11

Fig 9 Pyelogram Dog 84 Perforated artificial stone in the ureter two days. Note the extreme dilatation of the ureter and the very slight dilatation of the kidney pelvis. Note that the calyces are slightly enlarged but not flattened. From this pyeloureterogram one can see how small stones in the kidney pelvis could be more likely to engage in the ureter if it is dilated and pass down into the bladder than if the ureter had not been dilated.

Fig 10 Dog 37 Perforated artificial stone in left

ureter for 11 days slight infection. Note the enormous dilatation of the ureter and the slight enlargement of the kidney.

Fig 11 Pyeloureterogram of Dog 37. Note the enormous increase in size of the treated ureter also the increase in size of the kidney pelvis. Note the broadening of the calyces that while the calyces are broadened they are not flattened. A small stone in the pelvis of this kidney would simply roll down the ureter into the bladder.

Indications and contra indications This method is suitable for removing almost all types of ureteral stones and for small free stones in the kidney pelvis.

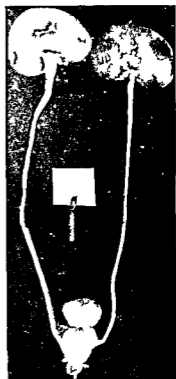
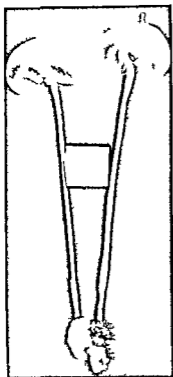
It is contra indicated for larger kidney stones and very large ureteral stones having a diameter of more than one and one half centimeters.

It is also contra indicated in the presence of severe infection or in case there is a very large amount of pus in the urine.

It is contra indicated when the stone completely obstrutes the ureter as in such case we will have no urine to produce a dilatation between the pathological stone and the perforated artificial stone or cork.

TECHNIQUE

Before this method of treatment is adopted a comprehensive diagnosis should be made. We should first prove that stones do exist and that they are in the kidney pelvis or ureter using the X-rays the pyelogram shadow catheter wax tip catheter and ureterogram to aid in making this diagnosis. We should know the number size and location of the stone or stones either in kidney or ureter we should ascertain whether or not urine is spurting from the ureter by observing the ureteral ejaculation or by use of the ureteral catheter. The presence or absence of infection should be known if present then the amount character and virulence of such



I g I I f t l t t l t
t t 4 l N t t d l t t t t h t
t l l g t t t h t f
I I l t m D N t t h
m l t t t t t t t d l t t t t l
l l t h d l t t t t t t l l
C l h l m l t t k l l
l d t t t d p t t h l l d t h

Fig 3
p f t d t t l t th t pa d t
f th l l d d p th t b t t m t
N t t l t t g m t f th r m l t t t g
th f j t t l l d th the d l t e t
C m t d m t th t t f d l t d t b t
Fig 4 D g P f t d t f l t t
4 i N t t l d l t t t f th t d t l m l
f t l k l I j t d t h l m t l p t

infection should be determined by appropriate method

If possible the functional value of the kidney should be determined and the degree of dilatation of the kidney pelvis and ureter above the pathological stone should be visualized by a pyeloureterogram

To determine the size of the pathological stone we compare the shadow cast by it with the shadow cast by a No 6 ureteral catheter or by using a segmented ureteral catheter each segment of which is 1 centimeter in length. We may also determine the size of the stone by making a ureterogram and comparing this shadow with the one cast by the pathological stone

When assured that there is stone in the ureter or kidney the operating cystoscope is passed and urine observed coming from the ureter. The artificial perforated stone or cork is now passed into the ureter leaving a small portion of the stone projecting into the bladder. Under no circumstances should the apparatus be so placed that the perforated artificial stone or cork is entirely out of the bladder one end of the artificial stone should



Fig 1
t t t t t t t d t h b d N t t h d l
Ob h l m l y t t t h l l t d l l
l l k k t t t t t m l

be left projecting into the bladder always. After holding the apparatus in place for a few moments and when it is observed that the *artificial perforated stone* is thoroughly wet and has become somewhat enlarged one should withdraw the stabilizer a millimeter or two noting the actual distance of withdrawal through the cystoscope. The introducer is now pushed into the ureter a distance equal to the withdrawal of the stabilizer. The stabilizer can now be removed entirely or withdrawn a half centimeter farther. The cystoscope is now removed and the apparatus remains in place in the ureter with the wire of the introducer projecting from the urethra. It is a better plan to keep the cystoscope in place until we determine that urine is or is not passing through the perforation of the perforated artificial stone. If urine is passing then we know that conditions are satisfactory for our purpose; if no urine is observed and the apparatus is properly in place in the ureter then the patient should be watched closely for development of pain because if anything occurs to obturate the perforation in the artificial perforated stone this fact will manifest itself by pain and the apparatus should be removed at once. Later another artificial perforated stone should be inserted if necessary. If any complications develop the artificial stone should be promptly removed and another inserted later as deemed necessary.

While the apparatus is in place X rays should be taken from time to time to determine the progress of the stone through the lumen of the ureter. When the shadow of the stone is in contact with the shadow of the introducer the apparatus should be removed permitting the stone to drop into the bladder. However until the dilatation has extended sufficiently far to reach the pathological stone and loosen it though that process should require several days the apparatus may be left in place carefully watching the dilatation so as to remove the apparatus when the pathological stone has descended.

The greater the distance between the pathological stone and the bladder the longer time it will be necessary for the perforated artificial stone to remain in place. For small

stones free in the kidney pelvis it is feasible to dilate the ureter and also slightly dilate the kidney pelvis by this method after which the patient should be thoroughly shaken on an orthopedic machine or the patient should ride over rough roads hoping thus to engage these small stones in the dilated ureter.

DANGERS OF PERMITTING STONES TO REMAIN IN EITHER KIDNEY OR URETER

A stone in the kidney pelvis or ureter must cause progressive injury to the important kidney parenchyma from the earliest formation of the stone to its removal. At the present time knowing the magnitude of an external ureterotomy physicians advise expectant treatment for these ureteral stones hoping that sooner or later the stones will pass spontaneously. Patients carry such stones in the ureter for years having repeated attacks of colic each attack advancing the stone a few centimeters but during all of this period of time a gradual painless dilatation of the kidney pelvis and destruction of the renal parenchyma is taking place further more these irritated and compromised tissues are exposed to the ever present danger of infection from organisms excreted by the kidney and thus the kidney is gradually but completely destroyed due to the uncontrolled dilatation and infection so that when the stone is passed there remains the irremediable damage to kidney and ureter.

With my method of ureteral dilatation available I would strongly advise that all cases of stone in the ureter or kidney be given active treatment as soon as the diagnosis is made. The presence of stone indicates immediate treatment.

CONCLUSIONS

To one skilled in cystoscopy this apparatus and method properly applied offers a simple means of dilating the ureter from the ureterovesical orifice to a given point or throughout the entire length of the ureter and of increasing the diameter of the ureteral lumen as desired and all without risk to the patient.

This method should replace cutting operations for ureteral stones and small free kidney stones to a very large extent.

GUNSHOT INJURIES OF THE LUNGS

REPORT OF 50 CASES

BY CAPTAIN CARL EGGER, MRC U S A

Chief Surgeon, 8th Central Postal Directory, Germany, 1918

IN a general way war surgery does not differ radically from that of peace times for most patients are taken care of according to general surgical principles. Though the types of injuries are manifold and of a nature infrequently encountered under ordinary circumstances they respond promptly to the usual measures and require no special skill. This is not true however when we consider gunshot wounds of special portions of the body such as the head, thorax or abdomen. So much has been learned since the beginning of the war about the treatment of these special conditions that it is necessary to be familiar with these advances in order to get the best results. The development of intrathoracic surgery during the last years of peace supplemented by the knowledge gained in the military hospitals have opened up a vast field for useful work that promises to save many lives. It is therefore important that surgeons who intend to go abroad to do War Surgery have certain principles in regard to treatment fixed in their mind. They must know what are the most common immediate causes of death and what may lead to severe and fatal complications. It is only by a thorough understanding of these that proper therapeutic measures can be instituted.

Injuries of the thorax and its contained organs are among the most frequent in war. This is easily understood when one considers the large exposed surface and the fact that even in protected positions the upper part of the body is more exposed than the lower. Statistics regarding the proportion of lung shots to all other injuries are available from many different fields of war; they vary considerably depending on whether troops are advancing or whether they are in stationary positions. Sauerbruch on the German side has reported one group of 22145 wounded with 8034 dead among whom were 836

with injuries of the lungs. This does not include those who succumbed to their wounds on the battlefield because it is extremely difficult to get correct reports of these. Only once during the war has he been able to examine the dead on the field in regard to their fatal injuries and among 300 soldiers thus examined he found 112 with lung shots or about 30 per cent. Adding to these the fatal terminations in the dressing stations and hospitals he concludes that the total mortality due to gunshot wounds of the thorax is somewhat over 40 per cent.

These figures show that injuries of the thorax are not as harmless as has been generally believed. This is due chiefly to the preponderance of heavy artillery with high explosive shells which produce injuries that are extensive, lacerated and prone to infection. Whatever good results are obtained and they are far better than in former wars are due to two factors: first the use of the small caliber smooth jacketed rifle bullet which produces small clean cut wounds that usually heal under conservative treatment and second to the advances that have been made in intrathoracic surgery during peace times. These modern methods of treatment however can be applied in a warfare only with rather fixed positions and under good aseptic conditions.

At this stage of the war it is not possible to give a complete resume of all lung injuries, their course and final result because no one is in a position to observe and treat a large number of cases continuously. Depending on whether one is stationed near the front or in a reserve hospital one sees lung injuries in different stages of convalescence. The severely injured with hemorrhage and fever are kept near the front until it is safe to transport them while the more lightly wounded are sent back early so that they may reach the reserve hospitals within a week.

The symptoms presented by patients with gunshot wounds of the thorax vary considerably. Some feel only a light blow when struck and remain in the upright position are able to continue in the combat for a while or even walk to the dressing station unaided. By far the greater number however present a distinct picture of distress. They feel the entrance of the bullet as a heavy blow and usually fall to the ground. A condition of shock of greater or less severity supervenes which may last for hours. The face is pale, pulse small and rapid, there is marked dyspnoea and frequently a moderate cyanosis. Distressing cough, pain in the chest and back and possibly immediate expectoration of blood point to an injury of the lungs. The pain is often referred to the upper abdomen or the shoulder.

Dyspnoea is the most constant symptom present. It may come on immediately and be so severe as absolutely to incapacitate the patient or it may not come on until after he reaches the dressing station. Its cause is found in the injury to the chest wall splintering of ribs giving rise to irritation of the pleura and causing pain in the collection of blood in the pleural cavity especially in the cases that have walked for long distances after being shot or in the entrance of air and the inability of a part of the lung to functionate.

Next to dyspnoea hæmoptysis is the most frequent symptom. The amount of blood varies a great deal and is not an indication of the severity of the internal injury. Some patients state that blood shot out of mouth and nose immediately they were struck, in others it does not make its appearance until several hours later. Due to their excitement or the darkness of the night patients often do not notice the blood at all and it is not observed until their reception into the hospital. Regarding the amount of blood it does not seem to matter whether the bullet perforated near the apex or the base of the lung. In the mild cases the bloody expectoration usually disappears in 3 to 5 days, it may however continue for several weeks in gradually diminishing amounts as in Case 2.

In those patients that have an opportunity

to rest for several days immediately after injury there is often no hæmoptysis at all showing that an early transport over the rough roads near the front aggravates the condition.

Subcutaneous emphysema in the region of the wound is frequently observed for the first few days but as it is usually limited and rapidly becomes absorbed it does not require much attention. It may even be beneficial in that it carries oxygen into the recesses of infected wounds. Two of the cases here reported showed this symptom No. 18 and 3 but no treatment was required for it.

A condition found in a great many patients with bullet wounds of the lungs is hæmorthorax. Of course in practically all cases in which the pleura or lung is injured there is a little bloody collection in the pleura which rapidly becomes absorbed but in a smaller number of patients in ten of my series there is a sufficiently large amount to produce symptoms. These symptoms consist in dyspnoea and pain due to compression of the lung in a serous pleuritis due to the presence of the blood acting as a foreign body or the blood becomes infected causing a so called traumatic empyema or more commonly an infected hæmorthorax. The condition may lead to a thickening of the pleura producing a contraction of the lung.

The type of projectile determines to a great degree the condition of the wound and the subsequent course. Small jacketed rifle bullets striking sagittally usually produce a narrow smooth channel which frequently closes immediately after the bullet has passed through. As a result bleeding is small in amount and even a pneumothorax does not form if air is not forcibly pressed into the pleura as the result of coughing. The entrance and exit wounds are about the size of a pea and crust over in a few days. Rarely are pieces of clothing or other foreign bodies carried inward thus diminishing the dangers of infection and empyema. Such patients can be transported a few days after the injury and may reach a reserve lazarett within a week. The following illustrate such light cases.

CASE 2 P H age 2 wounded May 26 1916
A rifle bullet entered the right upper arm passed through the biceps entered the thorax in axilla and passed out over the twelfth rib about the width of a finger's breadth from the midline. The patient did not lose consciousness. He expectorated blood two days. He felt weak but was not very sick. Much blood was lost from the thoracic wounds. Two weeks later he was walking about with all wounds healed. No symptoms were present in the lungs. The patient has anesthesia of the index and middle fingers and is unable to flex the distal joints of these two fingers.

CASE 3 H H age 39 wounded April 6 1916
A rifle bullet entered the right chest anteriorly below the nipple and passed out in the right costovertebral angle one inch from the spine. He did not faint. He coughed for a few days. There was blood tinged expectoration the first day. Although the bullet probably passed through the liver there were no symptoms referable to that organ. Both wounds were firmly healed after three weeks.

CASE 4 W C age 39 years wounded June 3 1916
A rifle bullet entered the right chest just below the clavicle about its middle passed through the lung and out below the pinous process of the fourth dorsal vertebra exactly in the midline. The entrance wound was the size of a pea that of the exit the size of a nickel. He did not faint. He had no fever. He spit blood for 4 days. There was moderate cough. He was on note of the right lower chest. As dullness and rales were not heard. He was able to walk later both wounds healed. He still has pain in the right lower chest on deep respiration. Respiratory sound was heard over both lungs.

In case the bullet does not pass all the way through but becomes lodged in the thoracic wall the symptoms may be no more severe as the following case shows.

CASE 5 F W age 29 wounded about 1 year before admission. He was lying on a railroad embankment when he was struck by fragments of a shell exploding about 4 feet away from him. Large holes were torn into both buttocks. He was unable to get up and thinks he was unconscious about 15 minutes. He ascribed the fire but emanated in his position for 4 hours before he could be moved. During this time he was stuck in the right chest felt great pain and had marked dyspnea. He had a cough before he was wounded but immediately after it became much worse and he expectorated blood for days. After many weeks the wounds in the buttocks healed and he returned to the Army. There were no symptoms referable to the lungs. About 5 months ago he noticed a small tender swelling in the left anterior chest which gradually increased in size and for which he sought relief. Examination showed a hard mass apparently a rifle bullet over the second and third ribs three inches from the median line positioned directly upward.

This was verified by X-ray which showed a faint shadow in the lung suggestive of the track of the bullet. However he had no symptoms. The bullet was easily removed under local anesthesia. It was lying in the subcutaneous tissue surrounded by about an ounce of turbid sterile fluid. In this case both lungs must have been perforated.

It frequently happens that the same bullet which perforates the lung produces a fracture of a rib the clavicle the scapula or the humerus and thereby prolongs the convalescence. This is illustrated by the next two cases.

CASE 6 D K age 33 wounded April 4 1916
A rifle bullet entered above the right clavicle passed downward and backward through the lung and made its exit through the infrapinnous fossa about two fingers below the scapular spine. He did not faint. He coughed and had bloody expectoration for 3 days. Two weeks later he was feeling fine. There were no lung symptoms. The entrance wound was healed but the exit wound about the size of a dime was still secreting probably due to a little bone fragment.

CASE 7 F L age 34 wounded April 28 1916
A rifle bullet entered the right anterior chest between the third and fourth ribs in the midclavicular line passed through the lung and scapula and became lodged under the skin about the middle of the infrapinnous fossa. The patient was sitting in a shell hole when struck did not fall over and did not faint. For about a half hour and again 3 hours later he had bloody expectoration but he has not had it since then. He had a cough which lasted about three weeks. He had dullness and absence of respiratory sounds over right base and moderate temperature for several weeks. The bullet was removed under local anesthesia. The wound drained for a long time but healed after six weeks. At that time the patient still had little pain on deep inspiration. Respiratory sounds were present. The general condition was good.

Wounds caused by artillery projectiles are usually quite different. Shrapnel balls may pass right through leaving a clean smooth wound as do rifle bullets but on account of their size they make larger openings. Due to their low speed they frequently lodge in the thoracic cavity and are more apt to carry in foreign bodies.

CASE 8 P H age 37 wounded June 3 1916
A shrapnel ball passed from above on the left downward and backward to the right. It undermined the skin of the lower jaw and neck about 3 inches came out just above the larynx and then entered the right thorax immediately below the clavicle about its middle. It passed through the lung and made its exit in the lower part of axilla.

The patient did not faint until about one hour after the injury. The entire musculature of the right chest became tremendously swollen evidently due to the severance of a vessel. There was no expectoration. He expectorated blood about an hour. He had a rather distressing cough which lasted about two weeks. There were no positive signs in the lungs. Examination was difficult on account of swollen muscles. Two weeks later both wounds were almost healed. The chest wall was normal. There were no signs in the lung. The temperature was normal throughout.

CASE 8. A H age 36 wounded April 11 1916. While standing over a trench pumping out after a shell exploded immediately above him. A hand grenade entered the left lower thorax posteriorly at the level of eighth dorsal vertebra traveled upward and to the right through the right lung and lodged under the skin of the right axilla. He felt very hot when struck and saw his legs gave way. He fell backward but had sufficient presence of mind to shout to his comrades in trench. Lung shot. While lying on his back blood oozed about out of his mouth with each expiration. He did not lose consciousness. He was dragged into trench by his friends and reached a dressing station about four hours later. Here he was kept for a week on his stretcher because he was losing so much blood. After some hours haemoptysis ceased and he could expectorate blood only when coughing. This continued for 8 to 10 days and then stopped and he returned. The bullet was removed under local anesthesia. Two weeks after injury both wounds healed. There was no cough, no sign in the lung. He was kept in bed on account of a large ulcer caused by pressure necrosis. During the early days when he bled so much he was not moved at all. He was not even undressed and as a result he was lying on his belt buckle which caused the necrosis.

Shell fragments because of their irregular size and shape produce large ragged wounds with considerable defect of tissue and often extensive injuries of ribs and chest wall. Many succumb as a result of the first shock. Others recover after more or less stormy convalescences.

CASE 9. W K age 30 wounded April 11 1916. A shell splinter entered above the right clavicle passed through the lung and out through the lower part of the right scapula. He was not very sick. He coughed and expectorated blood for about 3 days. Three weeks later the wounds were clean but were still secreting. No signs were present in the lungs. Patient walking about.

CASE 10. A R age 38 wounded February 16 1916. A shell splinter entered the left chest to the inner side of the scapula passed through the lung made its exit in the lower axilla and then passed through the arm shattering the humerus. Symptoms referable to the lungs were not severe. He ex-

pectorated blood to 3 days and then quickly recovered. The wounds healed in about 3 weeks. The comminuted compound fracture of the humerus however required prolonged treatment.

I report the following case to show that the late result of such perforating injuries of the lungs may be very good.

CASE 11. J M age 21 wounded about 7 months ago October 4 1915. A shell exploded at a distance of approximately 10 meters. He does not remember pain or anything as he lost consciousness immediately. He came to about 4 hours later in a dressing station and immediately after that he was transported on a wagon to a field hospital. He had severe pain in the right chest arm and right leg. He had great difficulty in breathing and for about 6 days severe cough and considerable expectoration of blood. He had fever for several days. The wounds healed slowly. He was admitted to our hospital for a fistula of the right leg leading to a shell fragment 12 inches embedded in the head of the tibia. At the time his thoracic wounds and arm were entirely healed. There were no signs in the lung and no symptoms referable to it. Shell fragment had entered just below the clavicle passed through the apex of the lung and then out through the upper end of the humerus shattering it. As a result of this he had a circumflex paralysis atrophy of deltoid and partial ankylosis of the shoulder. Function of elbow and hand are normal.

CASE 12. A E age 36 wounded April 8 1916 during a storm attack on a Russian position. A shell fragment entered at the acromion process tearing an opening about 1 inch in diameter passed through the lung and out to the right of the spinous process of the third dorsal vertebra. The exit wound was lacerated and about 2 inches long. The muscle of the right shoulder were much swollen and tender. The patient fell but did not faint. He was dressed on the field and remained there most of the day. Late that night he reached a field hospital. He expectorated a great deal of blood. Dullness and absent breathing developed at right base reaching to scapula.

A second piece of shell struck the patient in the right forearm lodging there and fracturing the radius. The wound secreted a great deal. The patient had a little fever all the time which reached about 104 about a week later. The exit wound was enlarged to facilitate drainage. There was gradual improvement until June 9 almost six weeks after the injury when the temperature again rose to 104. There was pain and swelling along the entire bullet canal. This was therefore laid wide open from acromion to wound of exit exposing the supraspinous fossa. Bone fragments and pus were evacuated. The hemothorax which the patient had developed after his injury had become entirely absorbed by this time and there were no symptoms referable to lung. Uninterrupted convalescence after the operation.

In case a bullet or a shell fragment becomes lodged in the lung or mediastinum but has not carried in foreign body thereby preventing infection the cure does not differ materially from that of perforating injury. I have seen a number of cases in which the bullet had become firmly embedded and which had light or no symptom referable to the lung. Whether they will cause trouble later is problematical but as by that time pleuritic adhesion will have formed localizing the shell they can then be attacked more easily and with less danger to the patient.

CASE 3. L. N. L. 3. udd April 1906
A rifle bullet entered the right chest the second rib it cut through the intercostal space and penetrated 4 inches. He had no respiratory distress. The wound healed. The only symptom was a pleuritic pain in the left chest. The patient was discharged.

CASE 4. J. H. 4. udd March 1906
A rifle bullet entered the left chest the first rib 4 to 5 days after the injury he coughed and expectorated blood. The wound healed. The patient was discharged.

CASE 5. C. N. 5. udd June 1906
A bullet penetrated the left chest the first rib 1 to 2 inches. The patient had no respiratory distress. The wound healed. The patient was discharged.

CASE 6. H. W. 6. udd June 1906
He was struck in the chest by a bullet. The wound healed. The patient was discharged.

entered above the right clavicle and lodged in the tissue a smaller one entered through the right axilla and according to the X-ray lodged in the lungs. He coughed for a few days but did not spit blood. Both wounds healed promptly and when the patient was admitted to the hospital a year later the X-ray showed both pleuritic scars well healed in place. The only symptoms referable to the lungs were no abnormal physical signs to be made out.

He came to us for fistula of the right hip the first time. He had been operated on fully four times but the bullet had not been found. The hip was ankylosed and there was a profuse discharge. After a diligent search I located the fistula in the hip ball in the anus of the thigh and removed it. The wounds healed in about four weeks.

The treatment of clean smooth wounds of the thorax and lungs is simple and strictly conservative. Patients should be put to bed at the earliest opportunity and kept with the upper part of the body elevated. One of the most important things is to give an early and sufficient dose of morphine which should be repeated at regular intervals. It quiets the patient removes his fear facilitates breathing and expectoration. The wounds should be covered with sterile dry gauze and the dressing not changed unnecessarily. Early transport especially over rough roads is to be avoided as it always aggravates the condition and frequently brings about a return of the bleeding. It will be seen from the cases here reported that a number of them were kept in a dug out dressing station for several days because their condition did not warrant transporting them. Those that are not moribund usually reach the field hospital within 24 hours after their injury. Most of them present a very sick appearance at their reception due to pain, dyspnoea and the distress of transport over the rough roads often under the enemy's fire. As far as possible they are here kept in separate barracks where the chief requirement for a cure absolute rest can be obtained. All are carefully observed and complications guarded against.

Three factors that materially influence the prognosis and that require attention are (1) hæmorrhage (2) the entrance of air into the pleural cavity and (3) infection.

Hæmorrhage presenting outside usually

comes from vessels of the chest wall and though the source may be in the intrathoracic organs. Bleeding from an intercostal artery or the internal mammary may lead to a fatal issue. If large in amount therefore the source should be looked for and if in the thoracic wall the vessel ligated. If difficulty is experienced in controlling bleeding a mass ligature or a Mickulitz tampon may have the desired effect.

Injuries of the large vessels passing through the thorax or of the vessel of the lungs may quickly terminate in death. Next to a double open pneumothorax these hemorrhages from large vessels are the most common cause of death in lung injuries on the battlefield. Hemoptysis although it may be severe as in Cases 8 and 11 is practically never fatal.

Bleeding from the lung substance itself is rarely fatal for the blood pressure of the pulmonary circulation is low and after a certain amount of blood has collected in the pleural cavity the lung is compressed and the vessels thereby obliterated.

Occasionally a secondary hemorrhage occurs usually in 8 to 14 days after the injury. Fortunately they are rare. They are due to disintegration of tissue or the erosion of a vessel in the bullet canal of the lungs. These hemorrhages come on suddenly and are often fatal after an uneventful convalescence there is a sudden change in the patient's condition. He becomes pale, pulse small and rapid, temperature drops and dullness in the chest increases and in a few hours death may ensue. One of my cases 25 had a mild secondary hemorrhage three weeks after injury.

Blood collecting in the pleural cavity is called hemothorax. The amount of fluid varies considerably. At times it does not rise to the angle of the scapula and becomes absorbed in a comparatively short time. No treatment is required except perhaps a Priessnitz. Cases 3, 6, 12 and 15 belong to this class. More often however the blood rises above the angle of the scapula and may give indications for surgical interference. Early puncture should be avoided because it may lead to a secondary hemorrhage and

because it favors infection. It is indicated only if symptoms of compression of the lung become alarming. Usually one should not puncture before the tenth day but then the removal of quantities of blood may be most beneficial. Patients with a hemothorax usually run a temperature for 7 to 10 days reaching its highest point about the fifth day 102 to 104 and then gradually subsiding. If the temperature keeps up one or two trappings will make it come down to normal. The following cases are typical of this condition.

CASE 17. H. S. age 3, wounded June 12, 1916. A rifle bullet passed through the right lower chest and probably the liver. Entrance between ninth and tenth rib in mid axillary line and exit between eleventh and twelfth rib 3 fingers from the median line. He did not faint. He expectorated blood for four days and after that had blood tinged mucus as long as the cough continued about eight days in all. The highest temperature on the second day was 103.6. The patient had dullness and absent respiratory sounds to one finger above the angle of the scapula. He had tenderness in the liver region. There was no rigidity of abdomen no vomiting. Two weeks after the injury both wounds were almost healed, temperature normal, dullness diminishing. Three weeks after the injury wounds healed. He has pain on deep inspiration of right lower chest. Respiratory sounds are heard over entire chest.

CASE 18. A. B. age 34, wounded May 2, 1916. A rifle bullet entered the right side between the eighth and ninth ribs in the mid axillary line passed through both lungs and emerged through the middle of the left scapula. He was dressed on the field and then transported to field hospital. When admitted there he looked very sick, had lost much blood on transport, his face was blue, pulse small and irregular and respiration difficult. Around the entrance wound there was a hematoma the size of a hand and also subcutaneous emphysema. A saline infusion was given, also suprarenin and morphine hypodermatically. The following day a diagnosis of hemothorax was made. This gradually increased in size with a steadily rising temperature reaching 104 on the seventh day. As there were marked symptoms of compression of the lung with displacement of the heart 800 cubic centimeters of a sanguinous fluid were aspirated. Marked improvement in general condition followed and the temperature dropped to 102 and then gradually diminished. The patient had hemoptysis for four days. Seven weeks after the injury both wounds were healed, there was little dullness left lower chest and pain on deep inspiration. He still coughs and has a yellowish expectoration, no odor, no temperature, general condition good. X-ray negative.

drawn down by his comrades. Breathing was very difficult. During the first hour his chief complaint was pain in the abdomen. He said he could not breathe. After an hour he felt very faint and tremulous. Hearing surgeons say that he was still probably alive. He was carried to a dugout for treatment where he regained consciousness. He told here that he lay because he was so sick that he could not breathe. He spat blood freely for a few minutes and then gradually diminished. During this time he was given no food or drink. Just before he died a rifle bullet had entered the left chest through the upper part of the scapula, passed through both lungs, and then out through the right upper arm at the attachment of the deltoid. The wound was clean and healed without any difficulty. When admitted to my service a month after the injury the patient was still very sick. He was anemic but marked dyspnea was running a temperature up to 106. He coughed a great deal and the expectation was at that time of death. There was a hemothorax present on the right side reaching to three fingers above the angle of scapula. He kept in bed in an upright position. A tracheotomy applied and inhalation and expectorant given. Gradual improvement set in. In the course of the next few weeks he was repeatedly afebrile and moving sometime a larger than again a smaller amount of blood tinged fluid. In spite of this the lung did not expand properly. Bullae formed there was bronchial breathing in part over the lower lobe and continued dyspnea. About three months after injury I discharged him from the Army and sent him to a farm for convalescence. Diagnosis at discharge: bilateral contraction of lungs, and thickened pleura.

In this case it was not the thickened pleura alone that prolonged the convalescence and left the patient rather disabled. It was actual destruction of lung substance. We have to consider here that the man was shot at short range 70 to 80 meters and it is well known that rifle bullets fired at that distance have not only a penetrating but also an explosive action. The prolonged hemoptysis and the fact that he was so very sick after the injury speak for this destruction. Had he been moved early the result might have been fatal.

Not all cases with a hemothorax run this rather smooth course. It frequently happens that the blood in the pleural cavity becomes infected. This infection may set in at once and give rise to the so called traumatic empyema recognized by immediate high temperature frequently with remissions and possibly a chill. In such case the infection

is usually carried in from without. The prognosis is bad. Early rib resection with ample drainage is the treatment. Most commonly the infection sets in gradually. The temperature which at first is somewhat elevated due to absorption becomes normal for a number of days and then again rises. Such secondary rises must always awaken the suspicion of a secondary empyema, a so called infected hemothorax. One should not hesitate to do an exploratory puncture early. In such pus is found aspiration alone may be sufficient or a rib is resected in the usual way. At times an empyema opens spontaneously through either the wound of entrance or exit. The source of infection may be the channel of the bullet in the lung substance or it may be carried in from without.

CASE 3. E. B. age 21 wounded May 13 1916 admitted to field hospital same day. A shrapnel ball had entered the anterior left chest between the second and third ribs and lodged there. He was admitted with severe dyspnea and rapid pulse no bleeding no fever. The patient had considerable pain in the left chest an extensive subcutaneous emphysema developed and a pneumohemothorax could be made out. Three days later pus exuded from the wound. The temperature had gradually risen and continued high about 103.4 for the next few days making a puncture advisable. Thirty cubic centimeter of dark blood was removed. The temperature subsided. Three weeks after the injury a portion of the eighth rib was removed under local anesthesia because the temperature had begun to rise again and a large amount of bloody pus evacuated. A shrapnel ball was felt over outer surface of scapula and was removed under local anesthesia. Two dressings and irrigations were administered daily and resulted in considerable improvement.

Six weeks after the injury the general condition was good there was still considerable pus discharge from the thorax. There was no cough. The prospect of cure good.

CASE 24. H. F. age 21 wounded April 28 1916. A shrapnel ball entered the left chest between the eighth and ninth ribs in the midaxillary line and passed through the lung and out under the left scapula fracturing a rib at exit. The patient did not faint. He expectorated blood for about 4 days. The next day a hemothorax was present temperature 103.6. The temperature then gradually subsided until it was normal in a week and remained that way a few days and then again went up reaching 103 about three weeks after the injury. The suppurated hemothorax ruptured spontaneously through the wound of exit. The latter was enlarged several bone plinters removed and a drainage tube inserted. When the temperature did

embedded in the chest wall or in the lung substance. Under such conditions this method is of course not practicable. Here one has to be guided by the means at one's command and by existing circumstances. During warfare with constantly shifting positions not much can be done; most patients will succumb to the primary shock, plus circulatory and respiratory disturbance or to a subsequent infection. About all one can do is to clean the wound in the thoracic wall as well as possible, cut away shreds of tissue and remove bone fragment and then insert a tampon and a large dressing. If an airtight cover is put over this the patient will certainly be more comfortable and a certain number will recover as the following case shows.

CASE 26. B. K., age 26, wounded March 14, 1916. While throwing hand grenade he was struck in the back by a fragment of an exploding shell. He felt a heavy blow and fell down. He wanted to speak but was unable to. Immediately he had severe dyspnea; he says he felt as if he were paralyzed inside. He was carried to a dressing station bleeding profusely from his mouth and also from the thoracic wound. Air and frothy blood were passing in and out. He coughed incessantly. His condition was critical. The entrance wound was in the posterior right chest region of eighth and ninth ribs. There was no wound of exit. The tissues were lacerated and infiltrated. The wound was cleaned and to stop the air passing in and out a tampon was snugly packed into the hole. A dressing was put outside of that and over the whole a firm adhesive plaster strapping. This brought great relief and improved the patient's condition.

The first dressing was changed 5 days later because thoroughly saturated with blood and secretions. The temperature was fairly low, the general condition improved. The wound was found clean; therefore tampon was removed and the wound edges were sutured.

During the next few days the temperature gradually rose until it reached 103 and then 104. Therefore a change of dressing was made six days after the injury. Thin bloody pus was seen to exude from between the sutures. The latter were removed and considerable pus evacuated. A drainage tube was inserted. After this there was gradual improvement in the patient's condition. Hemoptysis continued for only 2 to 3 days but a distressing cough lasted about eight weeks.

When admitted to my service he had a fistula of the posterior thoracic region, excreting a seropus. A probe entered upward and inward for about 15 centimeters. An X-ray with the probe in place showed a shell fragment roughly 1 inch square

near the tip of the probe. Under the impression that this piece of steel was the cause of the suppuration I operated on the patient under general anesthesia about ten weeks after his injury. I made a large skin flap as for a Schede operation, removed the eighth and ninth ribs which were fractured together with a greatly thickened pleura and numerous small embedded bone fragments. A cavity the size of a large fist was entered. The wall was smooth and rigid. A search for the shell fragment proved negative. It seemed therefore that the suppuration was due not to the piece of steel but to this rigid old empyema cavity. To obliterate it I also resected the seventh, sixth and fifth ribs and then did a decortication of the lung. It expanded well as soon as released. Even then with the lower lobe of the lung between my finger I was unable to feel the fragment and concluded it was embedded some place in the mediastinum. A small gauze strip was inserted and the wound then closed. The first few days after operation the patient's condition was bad but then he improved rapidly and after almost four weeks the wound had entirely closed.

What the tampon in this case apparently accomplished was that it allowed the lung to form adhesions over it, thus preventing a general pneumothorax and a general traumatic empyema. Whatever infection did take place was localized to the region below these adhesions. Unfortunately however such favorable results are not obtained in the majority of cases and for this reason many surgeons have looked for other ways to combat the condition.

To find the correct indication and treatment is not always easy but in view of the commonly bad results in the treatment of open pneumothorax by conservative means many surgeons have come to the conclusion that active surgical interference has to be resorted to if the surroundings warrant it. These favorable surroundings as to operating facilities and asepsis have been given in the position warfare now carried on at the West front. Numerous surgeons, chief among them Sauerbruch, Iandois, Burckhardt and Jahn, now operate on their cases of open pneumothorax with the aid of a simple positive pressure apparatus.

As soon as the patient is admitted to the field hospital he is prepared for operation. In case there is a small defect of the chest wall alone the lacerated wound edges are excised and the hole then closed by suture.

In perforating injuries of the chest and abdomen caused by rifle bullets or shrapnel balls in which the course of the canal would indicate that the stomach or intestines may be injured a primary laparotomy should be done as soon as the patient is admitted. Good results are obtained this way. The thorax wound is treated conservatively.

If however the injury is caused by a fragment of shell and an open pneumothorax has been produced it is better to do a transdiaphragmatic laparotomy. The channel is split and widened the lung drawn down and sutured to the thoracic wound. Then the edge of the diaphragmatic wound is likewise sutured to the thoracic window thus effectually closing off the pleural cavity.

Any injury done to the abdominal organs is then attended to through the diaphragmatic wound and a tampon inserted. Should the pleura become infected it is drained externally by a rib resection.

Left untreated the cases have a very bad prognosis they die of a general peritonitis or a suppurative pleuritis.

It not infrequently happens that injuries of other vital organs are associated with perforations of the thorax and lungs. They materially influence the prognosis and may even be the more important factor in determining whether a patient is to be permanently disabled or not. The following few cases will illustrate such conditions.

CASE 28 A R age 2 wounded June 3 1916. A rifle bullet entered the left chest between the sixth and seventh ribs in the midaxillary line passed downward and backward and came out over the spinous process of the third lumbar vertebra. He fell down and was immediately very sick. He bled a great deal from the wound of exit. He was dressed on the field and then carried to a dressing station where he was kept two days in precarious condition making removal impossible. When he arrived there he was very pale his pulse small and rapid he had severe dyspnea and complained of constant pain in the left chest and upper abdomen. He was left on his stretcher because of fear to move him and was given morphine and caffeine every hour. He coughed a great deal but did not spit blood. Toward evening he passed bloody urine and this continued in decreasing amounts for the next few days. Diagnosis kidney perforation.

On the third day his temperature reached the highest point 103.2 and then gradually subsided.

In addition to the usual symptoms of lung perforation he had distention of the abdomen with marked tenderness and rigidity in the left upper region. However this gradually subsided without forming an abscess.

Three weeks after the injury both wounds were firmly healed. He still has pain in the left chest on deep inspiration but aside from a few rales there are no abnormal signs. He has no symptoms referable to his kidney. There is no nerve disturbance. CASE 29 A I age 10 wounded June 10 1916. A shrapnel ball entered his left lateral chest between the eighth and ninth ribs tearing a hole 4 centimeters. It passed obliquely downward and to the right perforated the spinal cord and lodged in the depth. The patient fainted and when he regained consciousness he was unable to move his lower extremities.

The subsequent course was rather uneventful. He developed a moderate hemothorax which caused a temperature never above 100 and which subsided spontaneously. There was no hemoptysis at any time a cough continued for about a week. Two weeks after the injury the wound was clean and granulating well. Physical signs in chest were light.

An X ray showed the shrapnel ball about two finger breadths below the right kidney. As the patient complained of pain in that region I decided to remove it. I made an incision similar to the one for exposure of the ureter and brought into view the lower pole of the kidney and the upper end of the ureter. The bullet was embedded within the peritoneum by splitting the latter it was easily removed.

As far as the injury to the spinal cord was concerned there were more bruising and hemorrhage than actual destruction. Immediately after his injury the patient was able to move the right foot knee and hip but was unable to lift the limb. The left one was absolutely paralyzed. There was no disturbance of bladder or rectum.

Gradual improvement continued to take place however so that three weeks after the injury he had gained full control of his right leg and was also able to move the left ankle and toes. There was no sensory disturbance.

CASE 30 L G age 20 wounded March 27 1916. A rifle bullet fired at a distance of 600 to 800 meters entered at the inner border of the right scapula passed through the right lung and axilla emerged at the posterior axillary fold and then passed through the forearm entering at the radial and coming out at the ulnar border. It was a most extensive injury. While passing through the axilla the bullet severed the axilla artery and injured the brachial plexus. The patient did not feel severe pain it seemed to him that he had received a blow in the back. He did not faint. He jumped into the trench and went to be dressed by a sister and a friend. Immediately after being injured he felt his right arm hanging down helplessly by his side. He coughed

IS THE PURGATION OF PATIENTS BEFORE OPERATION JUSTIFIABLE?

A CLINICAL AND EXPERIMENTAL STUDY

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AS is well known it is a common custom to prepare patients for surgical operations by purging them. The writer has been so impressed at various times by the harmfulness of this procedure that he has come to question whether it is really necessary and if so why. A review of the literature and the questioning of surgical friends alike have failed to elicit satisfying answers to these queries. When asked why he purges before operations the average surgeon says that he wants the stomach and bowel empty when he cuts into them as in a gastro enterostomy. That fails to explain why he prepares in the same way for a tonsillectomy for the removal of a breast or the amputation of a finger. Besides as is well known he does not depend upon finding the viscera empty but uses clamps in all gastro intestinal cases. With these clamps it does not make much difference whether there are two or six ounces of fluid in a stretch of bowel. As Mayo has pointed out the difficulties and dangers of using such clamps in the colon are *increased* by purgation. It can easily be seen that the chances of soiling the peritoneum are greater with liquid than with solid faeces (1).

Moreover the surgeon must know that the small intestine is empty in from 7 to 9 hours after a meal. In seven years experience in radiographing the digestive tract I have seen perhaps a dozen cases in which the ileum contained food after fifteen hours (2). Since operations are usually performed in the morning from 1 to 12 hours after dinner there is certainly no need for giving a purgative to clear the small intestine. The only place left in which feces can stagnate is the colon and in most cases that also would empty itself spontaneously on the morning of operation if it were left alone. Failing this it could easily be cleared by enemata. I have

convinced myself by radiographing patients after they have taken an enema to clear out barium containing faeces that the colon can be emptied very thoroughly in this way. It would seem then that the preparatory purgation can be dispensed with if its only object is the emptying of the bowel. Enemas would serve just as well.

The anæsthetic. When cornered by these arguments some surgeons have taken refuge behind the skirts of the anæsthetist — they have said that her work requires the preparation. Apparently they do feel this way because when a man applies a cast in his office he doesn't think of preparing the patient but if the same thing is done in a hospital after the administration of a little ether purgation is deemed essential. I immediately questioned some of the leading anæsthetists of this city who promptly disclaimed any desire for pre operative purgation of their patients. They had not observed any difference between the behavior of emergency and 'prepared' patients so long as their stomachs were empty.

Fear of auto intoxication. Other men have expressed a fear that the presence of faeces in the bowel might lead to the absorption of toxins. Here again I would suggest that there is no need for alarming ourselves over something that has never troubled the majority of people. Why should we be worrying about auto intoxication in a patient whose bowels have always moved regularly or who feels none the worse for four or five days constipation? The surgeon may answer that he fits the preparation to the case that such patients are not purged but from conversation with head nurses and a perusal of the instruction sheets tacked up in some busy hospitals I fear that such discrimination is not often employed. If there is to be any absorption of toxins it seems more reasonable to suppose that it would be from churned

liquid contents and not from dry masses lying quietly in the gut (3). Besides the bacteria in solid feces are for the most part dead while those in the liquid defecation are alive and possibly increased in virulence. Karl Meyer tells me that solid feces tend to restrain the growth of pathogenic bacteria in most people. For instance in typhoid carriers it is practically impossible to cultivate bacilli from solid stools but if a purgative be given the liquid feces may be found swarming with typhoid bacilli. The flora of the liquid stool will be quite different from that in the solid stool of the same person perhaps because the colon bacilli lose some of their restraining effect on their more pathogenic bacteria. Thus bacilli lifted from solid feces generally appear in clumps while those from liquid feces tend to grow as streptococci.

Normally the bacteria cannot get through the mucous membrane of the gut but those who have studied this problem in various ways agree that it does not take much to upset the protective mechanism or to break down the barrier. Thus in dogs slight abrasion of the superficial mucous membrane produced by round worms are enough to let the bacteria through to the mesenteric lymph gland (4). Barker included that anything produced in excessive action of the intestinal gland is likely to open up path of entry (5). Fillet and Fatigue (6) investigated for a few days would let down the barrier. Meyer found that a number of his rabbits that were purged developed positive blood cultures. The experiment is enough to show that the mechanism which protects our bodies from invasion by intestinal bacteria is delicate and in itself will not be much to meddle with it before operation by starving and purging. Such preparation is just as likely to increase the danger from auto-infection as to diminish them. Certainly we know that many people feel miserable and poisoned for a few days after purgation they are weakened and feel below par.

Fear of gas pains. Another motive back of the so called preperium is the desire to avoid gas pains. Unfortunately most physi-

cians seem to have the idea that flatulence is due primarily to the fermentation of intestinal contents and that it can be stopped by cleansing the bowel. The work on experimental ileus shows that this is not so. Kader in his interesting monograph (7) has pointed out that there is little difference in the amount of gas accumulating in isolated loop of dog small intestine which have been filled with material expressed from adjoining loops or emptied and washed out with physiological salt solution. Very little gas was found in either case unless the circulation was interfered with. If the mesenteric arteries or more particularly if the veins were tied the loop soon became enormously distended. Lichtenstern has pointed out also that in man the tremendous accumulation of gas above a slowly formed stenosis of the colon is not generally associated with meteorism while on the other hand a little patch of peritonitis or a pinching or incarceration of a small loop of bowel will in a few hours give rise to an enormous tympanite (8).

The thing to be desired is not a clean bowel but a *normal mesenteric circulation*. A number of investigators have shown that the large amount of gas constantly being formed in the bowel of herbivorous animals are rapidly carried off by the circulation and excreted by the lungs (9). The delicate mechanism underlying this process can easily be overthrown by upset in the motility of the bowel by disturbance in the circulation or by hanging in the secretory and absorptive function of the mucous membrane. One would think that the last thing the surgeon should want to do would be to tinker with this mechanism before an abdominal operation. Schirbeck, Woodvatt and Graham (10) have shown that the blood may not only fail to carry the gas away but it may even excrete some into the bowel. Such an exhalation would account better for the sudden accumulation of gas so frequently seen in man.

It is common knowledge that in many sensitive people purgation will be followed by alarming flatulence and distention. This tendency for the bowel to fill up with gas after a purge is very annoying to the radiologist when he tries to prepare his patients

for gall bladder or kidney plates. Many have discontinued such preparation as they consider that the gas resulting from the cathartic is a more disturbing factor in the interpretation of the roentgen plate than the fecal contents of the colon. (11) Surgeons have confessed to me that some of their patients have almost died from pseudo ileus and abdominal distention when the abdomen had not been opened at all. In one case a large, healthy looking man entered the hospital to have a cast applied for his back. When he discovered that he was supposed to submit to strapping orders and take a dose of castor oil he called up the surgeon (one of the best known men in the West) and told him that he never was constipated and that laxatives always upset him fearfully. The doctor insisted that preparation was essential so the patient was purged violently for two days. He then became so distended with gas that his life was temporarily imperiled and the cast was removed barely in time to save him. If purgation will do this when the abdomen is not opened, how much more likely is it to endanger life when the bowel has suffered the added insults of handling, exposure, and sewing?

Fear of peritonitis. Emmet Rixford has suggested to me that the practice of purgation before operations may have originated among the early American gynecologists. These men feared peritonitis a great deal and as Thomas says, if this should occur and the bowels have to be kept bound for while it would be well to have them empty and ready for the storage of feces. Thomas purged his patients every other day for a week preceding operation. (12) Such ideas should not influence the modern surgeon who has so much less to fear from peritonitis. Now that his main concern seems to be just the opposite, i.e. to have the bowels move shortly after the operation, we should expect he would plan to leave some material in the cecum to facilitate the resumption of colonic activity. With a strange inconsistency the surgeon often insists upon a movement on the fourth day when he has done everything in his power to prevent it by first cleaning the patient out and then by withholding food—

particularly food that will leave a fecal residuum.

The origin of the idea of preparation. After studying the answers given by my surgical brethren and after reviewing the literature, it seems to me most probable that the practice has arisen from a vague idea that *something* ought to be done to get the patient into good condition. The idea was well expressed by a woman who once refused to take an injection of salvarsan because she had not been given a course of calomel beforehand. When it was explained to her that such was not the custom, she said she would have to look around and find a doctor who would put her on a special diet who would starve her or do *something* in the line of preparation. She was sure that no such serious procedure should be submitted to without preliminary treatment.

Now where can such a deep rooted and wide spread idea have originated? We may be sure that it will be found running far back into the history of medicine because the housewife's ideas of one age are echoes of the best medical theory two hundred years before. A little reading soon convinced me that this desire for preparation must be a relic of medical practice two thousand and more years ago. The idea can be traced back through humoral pathology and even to the dawn of history. In groping around for a cause for disease, primitive man reasoned that if feces and vomitus are foul, the body must be in the best condition when most free from these substances. As Burton (13) tells us in his *Anatomy of Melancholy* (1621) purges scour the body of vomit, urine, sweat, of all manner of superfluities and keep it clean. According to Herodotus, the Egyptians took an emetic and a purge once a month to keep in good condition, just as many people now take a dose of calomel. Galen (14) had the idea that every purgative, by some specific property attracts and as it were sucks to it the humor to which it has a natural affinity in like manner as the magnet attracts iron. Holy Abbas went still further. He maintained that the purge goes to the part where its cognate humor is lodged from which both are expelled and returned to the bowels.

together (15) Burton also speaks of giving clysters and suppositories to draw the humor from the brain and heart to the more noble parts (16) Later writers took the theories and added to them The following quotation are offered as sample of medical thought a hundred or more years ago In the first English *Treatise of Physic* printed in 1496-1796 Cullen (17) says "Purging has the effect of diminishing the activity of the sanguiferous system and of obviating its inflammatory state Another physician writing in 1819 says "The stimulus of purgative action it enlivenizes the languid and torpid state of the system and induces actions that finally conduce to invigorate and invigorate and invigorate the system (18)"

One can easily see why men holding such views of purgatives should give them to healthy persons who were about to undergo some radical and who wished to be in the best possible condition We find that they purged the patients in surgery those who were to be bled and those who were to receive emetics (19) But let us tell us that they even prepared the patient who was to be purged by giving him some laxatives and purgatives (20) Carneade the Academic purged himself before entering upon a debate with Zeno the Stoic (21) His idea was that if hellebore the drug used sometimes cured madmen it should sharpen the wits of the sane Naturally when medicine came into vogue the candidates were purged It is interesting that a early as 1496 Cullen questioned the value of

the *pretended preparatory courses of medicine* (italics mine) He remarks that other medicinal effects have sometimes appeared (22) Jenner apparently had too much sense to advise purgative before vaccination although others did prepare their patients (23) A young American medical student (24) who was in London in 1801 writes "When inoculated Woodville gave the people five grains of rhubarb and ordered five grains more to be taken in about a week *principally to quiet the parents*" Men who were to be tortured for the extortion of confessions were prepared by the giving of purgative (25) Although it was believed that if

the accused were innocent God would stand by him and make his suffering so bearable that he would not have to perjure himself it was thought best to have him in as good physical condition as possible

It was not so easy to find references to purgation before operation in the earlier works on surgery perhaps because such books deal almost entirely with wounds and fractures One of the few non-emergency operations done by the ancients was the removal of the cancerous breast Let us see why the patients were purged Galen held that the cancer would not have grown if the function of the part had not been depressed by an evil humor such as black bile This had to be purged away before surgery could have any prospect of success These theories were still current in the time of Ambrose Pare (26)

Some may say what is the use of dragging in all this ancient history those ideas cannot influence us today Let us not be too sure of that let us see when they were given up and why I personally had never realized how enduring the old theories were until I found the learned Doctor Adams in 1847 seriously discussing the pro and cons of some ancient quarrel between Galen and his successors (28) The fact is that humoral pathology could only be downed by exact knowledge gained at the autopsy table and in the laboratory It is hard to realize how recently this change has come Even Rokitsky's great work on pathology written in 1841-1846 was marred by his attempt to revamp the ancient drive about solidism and humoralism (9) It was left to Virchow (1846) with his *Cellular Pathology* to break away entirely from the old ideas Pasteur applied his research to medicine and laid the foundation of bacteriology in the years from 1877 to 1885 and Lister devised antiseptic surgery in 1867 Ideas which have been held for two thousand years cannot be uprooted entirely in seventy years and no student of history will doubt that they are influencing us today Practices always tend to persist long after the motive is forgotten If this practice of purging before operations is really based upon humoral pathology it should be given up (not mitigated) unless it

can find new support in physiologic and pharmacologic research

Preparation is being given up If purgation is really a good preparation for an ordeal if it "energizes the vital powers" why isn't it employed by athletes? Why doesn't the college trainer give the track team a dose of salts all around the night before the big meet? Any one who has been in athletics knows that that is about the last thing on earth he would do. As Oliver Wendell Holmes (7) says:

If it were known that a prize fighter were to have a drastic purgative administered two or three days before a contest, no one will question that it would affect the betting on his side unfavorably. He goes on to say that if this be true for a powerful man in perfect health, how much more true it must be of the sick man battling for his life.

The fact that the most serious and complicated operations are done successfully in research laboratories on animals which are not purged shows that there is nothing in the operation itself that necessitates such preparation. Still more convincing is the argument that nothing but good results have followed the abandonment of routine purgation in human cases (30). I have talked with a number of busy surgeons who for years have not been purging their operative cases and who are all enthusiastic about their improved results. They all comment on the greatly decreased amount of vomiting, flatulence, dynamic ileus and gas pains. Very significant also is the fact that others who still prepare have made the process much milder. Where it used to be ten grains of calomel and ten grains of jalap or two compound cathartic pills, it is now a laxative or an ounce of castor oil given 48 hours before operation so that as the surgeons admit the patient will have time to recover a little. When a review of the literature showed this marked tendency of surgeons all over the country to diminish the severity of purgation or to discontinue it altogether, I began to question the need for writing this article. Further investigation showed, however, that there are some reactionaries who are pleading for a return to drastic preparation and claiming that it is a sure cure for all postoperative

troubles (31). Another thing that has induced me to publish at this time is the fact that a number of surgeons particularly those in the country, have told me they did not dare say anything about having given up preparatory purgation for fear that in case of accident or of a damage suit they might be condemned for their unwarranted innovations. It is interesting that almost all of these men state that they gave up the routine purge at the suggestion of their nurses who kept asking why it is that emergency appendicitis cases have such quiet postoperative courses as compared with the well prepared interval ones. During the last four years I have questioned a large number of experienced nurses asking them which they would prefer looking after an emergency or a prepared abdominal case and the answer has always come back unhesitatingly.

The emergency case of course. They have all agreed that the stormiest after courses and the worst gas pains are met with in the elaborately prepared cases.

EXPERIMENTAL WORK

It was with the hope of throwing a little experimental light on this subject that Mr. Fletcher B. Taylor and I undertook some work on purged animals. It seemed reasonable to suppose that if purgatives have either tonic or depressant effects on the gut these effects should be demonstrable in the excised segments which will contract rhythmically in warm oxygenated Ringer's solution. I was interested to see if any change could be shown in the gradients of rhythmicity, irritability or latent period. I have suggested elsewhere that the downward progress of food through the tract depends largely upon a gradient of muscle forces of irritability and rhythmicity, i.e. the upper part of the bowel not only contracts more powerfully under stimulus but it reacts more promptly and beats more rapidly than do the parts lower down (3). The intestinal contents move from the more active irritable regions above toward the more sluggish less irritable regions below. It can easily be seen that the regular uninterrupted progression of material in the bowel must depend on the smoothness of this

gradient. An upset in the gradient might occur if the purgative should happen to depress or fatigue the upper end of the intestine more than the lower (33). Even a general uniform exhaustion of the muscle might be a serious complication after a laparotomy when the surgeon often wants the bowel to react promptly to carminatives or purgative. So often the deplorable state of a patient is due to the fact that when the postoperative purgative fails to act stronger and stronger ones are given and are retained.

A full report of the experiment will be published elsewhere. Rabbits were used because of the ease of segment from their intestine and their regularity in Ringer solution that deviates from normal is easily detected. In spite of addition which is ideal for fermentation, the intestine of the normal rabbit contains practically no gas, the wall is atonic and grasps their content firmly. Five animals received castor oil four mg., magnesium sulphate five c.c., three calomel and three compound tincture of jalap. For the most part mildly laxative doses were used. If the animal had been purged to the extent that patient is purged the changes in the bowel would probably have been more striking. The drug was given about noon and the animal was killed the next morning at nine o'clock. Segments for study were taken from five different places in the bowel. Six well purged animals were apathetic and looked sick. The bowel of the animals were injected full of fluid in large amounts and were flabby. Then irritable here and there and inclined to contract down into hard white cords. When the excised segments were put into the warm Ringer solution their contraction was weak and irregular and they soon became fatigued. They were less sensitive to some drugs applied locally in some cases the dose had to be increased one hundred times to produce any effect. The importance of this observation will be evident to the man who knew how difficult it is to make the bowel respond to drugs after purgation (34).

Of even moderately purged animals six showed some intestinal and other abnormal

ity. In three the segments contracted poorly. Some of the animals which received doses too small to produce purgation were also full of gas and showed signs of intestinal paresis.

From these observations magnesium sulphate would seem to be the most objectionable purgative for the surgeon. On account of its well known action in preventing the absorption of water by the bowel the intestines in the animal purged by this drug were distended and full of fluid. Calomel and cascara did not seem to poison or fatigue the segments as did castor oil, magnesium sulphate and jalap. With calomel the segments beat well with a large amplitude and slow regular rhythm.

The gradient of rhythm in the excised segment was irregular only in the animal that received castor oil. Probably this gradient would have been found to be more upset if it had been studied in the intact intestine with the animals opened under salt solution. Records obtained in this way from diarrhetic animals showed very irregular gradients of rhythm (35). More striking deviations from normal were found when the latent periods of the segments were studied. Normally there is a certain gradation from short latent period in the duodenum and jejunum to longer one in the terminal ileum. In the purged animals some segments were more irritable than normal and had shorter latent periods while others would hardly respond at all to the strongest current. Colic and gas pains might be due to the distention of such paralytic regions by gas forced into them and held there by more irritable and powerful loops above and below. In the normal intestine the gas if not immediately absorbed would promptly move aborally because the oral end of the loop would be stronger, quicker and more irritable than the aboral end.

The injection of the intestinal wall and the engorgement of the mesenteric vessels noted in many of the rabbits deserve mention. It has been observed after purgation in man. Such a disturbance in circulation might upset the delicate balance between the gases in the intestine and those in the blood.

SUGGESTIONS

That this paper may not close with purely destructive criticism the following suggestions are offered. They have all been put into practice by surgical friends whose reports so far have been encouraging. Naturally it is not to be expected that the measures recommended will entirely eliminate gas pains. Much will always depend upon the nature of the operation, the constitution of the patient, the amount of ether used, the amount of peritoneal drying, and the gentleness or roughness of the operator.

Unless there is serious gastro intestinal stasis from obstructing lesions at the pylorus or in the bowel the patient should eat his usual dinner. As Crile says, "It is a serious mistake to starve a patient too long (or to purge too severely) before an operation" (36).

Unless the operation is set for an early hour in the morning he may sleep in his own bed the night before. If he is very nervous and apprehensive he had better take a full dose of adalin or other soporific to insure rest.

If the operation be set after 10 a.m. and if there be no lesion causing gastric stasis a breakfast may be given consisting of the patient's usual coffee with a roll or some toast or a plate of smooth mush. No physiologist would ever expect to have an animal's bowel tonic and in good condition for class demonstration or for research experiments unless food had been given that morning (37). Mr. Taylor and I studied excised segments from four rabbits starved for four or five days and found the contractions diminished in amplitude and strength. Ordinarily a light breakfast should leave the stomach in two or three hours. In patients with duodenal ulcer, gall stones, or achlorhydria most of it would probably be gone in an hour. Experience alone will show whether or not this suggestion is practical and the results worthy of the extra trouble. It is very possible that fear and apprehension will so lengthen the emptying time in many people that food will remain to interfere with the action of the anæsthetic.

If the patient's bowels move normally every day and particularly if they move on the morning of the operation as they prob-

ably will do if the breakfast is allowed, no enema should be given. Enemas need be given only to those who are definitely constipated or who are to undergo operation on the lower colon or on the pelvic organs.

Gas oxygen should be used when possible as it upsets the digestive tract very much less than ether does.

Solid food should be given as soon after operation as possible on account of its tonic effect on the tract and its tendency to restore the downward currents (38). The thing to be avoided is the cellulose in fruits, salads, and green vegetables. Give the patient all the water he wants. Unless it is very cold it will not stimulate peristalsis very much. It certainly cannot do harm in the lower bowel as it is absorbed so rapidly in the duodenum and upper jejunum. Given freely it often stops vomiting, it washes the stomach, it lessens the dangers of retching as vomiting is made so much easier, and a considerable amount of fluid will generally be retained (39). This enables the surgeon to dispense with the Murphy drip which undoubtedly tends to keep up reverse peristalsis and in many cases is largely responsible for the nausea and gas pains. Weeks' article on the subject is timely (40). He might have added that this apparatus is being used more and more as a fetch after short operations in which there has been no loss of fluids and no shock.

Avoid postoperative purgation, certainly do not give it as a routine on the fourth day. So often the patient's after course is uneventful until this dose is given. There is no harm done if his bowels do not move especially if he hasn't been getting much food or if he were purged beforehand (41). McPherson (42) has shown very conclusively on 644 consecutive cases that the routine purgation after confinement is not only useless but harmful. The women were placed alternately in Wards A and B. Those in A had no catharsis; those in B were subjected to the usual routine. Of the 322 in Ward B 28 had some fever (over 100.4) during the puerperium of the 3 2 not purged, only 3 had fever and one of these had a mammary abscess. A considerable number of the women

who were left alone had normal bowel movements others were given an enema every third day. None of them had any of the symptoms supposed to go with auto-intoxication. There was less danger from infection by the spreading of loose movements over the vulva. The mothers were saved much discomfort and the nurses end less labor. McPherson rightly concludes that the lowgrade fever of the puerperium can be due to the catharsis to the stirring up of the colonic bacteria and not to any constipation.

Many surgeons will probably answer that some of their postoperative patients would have died with intestinal paralysis if they had not employed heroic measures and had not forced a bowel movement through. Richardson tells me that after years of consultation on such cases he is satisfied that the purges do not cure the *deperitonasias* when they succeed they simply show that peritonitis if present was not extensive enough to preclude recovery. If the intoxication is severe enough the bowels will never move again and the patient will die no matter what is done (43). If the purge is simply a test to distinguish between the curable and the incurable we ought often to restrain our curiosity as the testing sometimes takes away the little chance the patient did have for recovery.

The prompt use of salines after operations is due largely to the teaching of Lawson Tait. He maintained that we must begin active purgation the minute distention appears. No time must be lost because later the purge may not work. He admitted that he had no right to say that he cured peritonitis but this I do know that the moment we see distention we purge and if we succeed in purging the patient recovers if not she dies. Therefore I am content to say that at least *ac pre-ent peritonitis* (italics mine) and it is for that purpose that my routine treatment is directed (44). Whatever we may think of the practice itself it would seem that an antirvivsectionist a man who in 1892 could sneer at the fashionable germ theory of disease and who thought peritonitis was due to a disturbance of the ebb and flow of the

serous stream in the peritoneum is hardly the one to be directing the thought of physicians in 1917.

SUMMARY

To sum up briefly the reasons for avoiding purgatives before operations are

- 1 Some of the purgatives owe their effects to the fact that they are irritant poisons that must be removed quickly from the body. Others act by interfering with intestinal absorption and by upsetting the balance of salts. In either case they bring about pathological conditions. The body is weakened and not strengthened.

- We know now that the dehydration of the body and the upset in salt balance are bad particularly before an operation in which there may be hemorrhage and vomiting.

- 3 With magnesium sulphate there may be an increased amount of fluid in the bowel to disturb those who want it empty. In operations on the colon liquid contents are harder to control mechanically than are solid masses.

- 4 There is an increased growth of bacteria. There is some evidence that there is an increased absorption of toxins and a greater permeability of the mucous membrane to bacteria. Undigested food may be carried down into the colon to supply increased pabulum for the bacteria.

- 5 By weakening some parts of the bowel and making others more irritable the even flow of material from stomach to anus is rendered impossible.

- 6 Whether from disturbances in motility or in absorption in the circulation or in the bacterial conditions there certainly is a tendency to flatulence and distention.

- 7 When the bowels must move frequently during the night the loss of sleep is considerable. The purgation is particularly trying if the patient is wearing a large cast has a broken leg or other painful lesion which makes each resort to the bedpan an ordeal.

- 8 If the patient should happen to have some intestinal obstruction a gangrenous appendix a badly diseased Meckel's diverticulum or adhesions forming around some pus purgation may directly cause death.

9 Purgation makes the bowel react so poorly to drugs that there may be grave difficulties in meeting postoperative emergencies

10 Emptying the bowel by starvation and purging makes the resumption of colonic activity much more difficult. The colon must be filled and distended to a certain extent before it will empty

11 The fact that children and nervous women will sometimes begin vomiting during the night *before* the operation shows that the purge must be responsible for some of the postoperative nausea and vomiting. The ether adds the finishing touches to what was begun the night before

It is suggested that food be given as late as possible before operation, that even enemas be avoided if not absolutely necessary, that water and solid food be given by mouth as soon after operation as possible, and that purgatives be avoided after operation as well as before

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LIGATION OF THE SPLENIC ARTERY FOR BANTIS DISEASE

REPORT OF CASE EXPERIMENTAL STUDIES¹

BY ALEXANDER W. BLAIN, MD, FACS, DETROIT, MICHIGAN

A. d. g. S. geo. S. M. ry. Hosp. 1 J. S. g. Harpe H. f. 1

SURGERY of the spleen is rapidly assuming a definite role in the field of abdominal surgery. Its removal was a recognized operation among the ancient Romans and Greeks and at intervals during the middle ages. It is not the purpose of this paper to review the history of voluminous literature of splenic diseases or a discussion of the present chaotic classification (1) but to consider a method of treating or disposing of the spleen in cases where it is the basic pathological factor and its removal is deemed necessary. The removal of the spleen will effect a cure in some maladies (2) and its indications are constantly being broadened (3).

CASE REPORT

Mr. I., age 38, Greek laborer, was admitted to Harper Hospital March 5, 1913. Temperature 98, pulse 80.

Complaint. Pain in left side over region of stomach and spleen. Enlargement in upper left abdominal quadrant. Shortness of breath, general weakness, unable to work for past two months. **Family.** Father and mother dead, cause unknown. He in good health. Three sons and one daughter, ages 7, 10, 13, in good health. In 804 had distal attacks in the fall of every year. Has never had chills or fever.

The patient dates the present trouble since 1894 when he first noticed the tumor in the left side. Since then it has been gradually getting larger. There is shortness of breath, marked of late also pains in side. He has not been constipated, his appetite is good, he has never been troubled with indigestion. Physical examination disclosed a large tumor filling the whole left side of the abdomen and extending about three inches below the umbilicus. The splenic notch could be felt very plainly which left no doubt as to the organ involved.

Urine: Specific gravity 1.020, negative. Blood examination on admission showed erythrocytes 3,84,000, leucocytes 5,500, polymorpho-nuclears 58, large lymphocytes 5, small lymphocytes 35, eosinophils 15.

No plasmodia found. Hemoglobin 70.

Stool occult blood negative.

A diagnosis of Banti's disease was made and as the liver was normal and the patient was free from ascites, splenectomy was decided upon.

Operation. March 25, 9:30. Ether anesthesia. Incision through left rectus 13 centimeters. The spleen as enormous, there was no free fluid, the liver was slightly enlarged, the spleen free on the anterior surface but firmly bound on the posterior surface and to the diaphragm. The veins from the spleen were enormously dilated and extremely thin.

Splenectomy was considered too hazardous after attempting to divide some of the adhesions and I decided to ligate the splenic artery. William Mayo (4) suggested (1910) the possibility of controlling the amount of secretion from the spleen by ligation of an arterial division as is done in the thyroid for hyperthyroidism. However, this or the destruction of the whole organ by ligating the artery had never before been attempted in the human subject. The artery was caught about 3 centimeters from the spleen, clamped in a hæmostat and ligated with chromic catgut in two places. There was an immediate shrinkage of about one fourth in the total volume of the organ. The wound was closed without drainage.

The patient reacted promptly but on the second day the temperature gradually rose to 102 and the pulse to 140. That evening he developed most bronchial rales, was much distressed in breathing and had a slight cough, which was infrequent suppressed. Morphine was given once during the second day for pain. On the third day he started to improve, the pulse and temperature became normal and the patient started to expectorate white frothy mucus. The patient was up in chair on the twelfth day and allowed to walk out of the hospital on the seventeenth day with wound entirely healed.

He reported to my office a few days later (April 10, 1913). His temperature and pulse were normal but a slight painful bulging was noted in the center of the wound. This was opened with a hæmostat and a large amount of broken down splenic tissue exuded from the wound. The wound was dressed frequently and finally healed in about six weeks. The hemoglobin rose to 90, the stoma and he said he was stronger than before operation.



Fig 1. Roentgenogram of normal splenic artery (injected) showing distribution of artery.

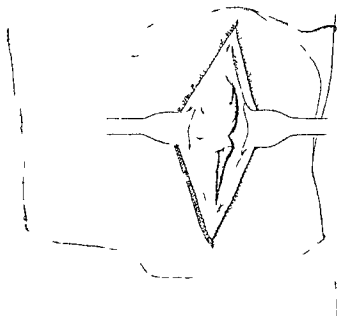


Fig 2. Diagram illustrating ligation of the splenic artery. D, Diaphragm; S, spleen; A, artery; V, vein; U, umbilicus.

The patient said he was cured and returned to light work before the sinus was completely healed. It is now over four and one half years since operation and the patient has remained entirely well and is doing heavy work.

As might be expected I was severely criticized by some of my colleagues at the time but I firmly believe the patient would have died had I attempted to remove the organ.

EXPERIMENTAL STUDIES

In the summer of 1913 I began a series of experimental studies on dogs, rabbits and guinea pigs. The latter were soon discarded owing to the technical difficulty in such small animals. Twelve dogs were operated upon at this time. In six cases the artery was ligated, in four the veins, and in two parts of the arteries.

In the spring of 1917 I began a second series of experiments. These were carried out by a student assistant and most of the dogs died in about ten days due to some technical error.

This was followed by a third series of twelve dogs, six ligations of the artery, four of the veins and two of the veins and artery. Jamieson (5) of New Orleans has carried out some like experiments on dogs.

We will eliminate the second series from our work as the postmortems in many cases showed that the artery itself had not been ligated. None of the animals died in the first or third series and only some of them were subjected to secondary operation.

In the ligation of the artery there is an immediate shrinkage in the spleen pulp while in the ligation of the veins a swelling too near double of the total size and weight of the gland. The animals do not seem to suffer any pain but are quite drowsy and thirsty on the second and third day. All of our work was done under strict antiseptic methods and the wounds except for superficial stitch infection remained clean. Silk as a suture material was used as a matter of routine. Some of the animals of the first series were kept under observation for more than a year.

The following conclusions were drawn from the experimental work. If strict asepsis (or antisepsis) is observed the operation of ligation of the artery or veins of the normal spleen in dogs can be carried out without mortality. In the work of Jamieson above referred to the splenic pedicle was ligated and only four of his dogs survived over a



atrophied organ was found massed in the omentum except where some of the arteries were ligated in which case these were areas of local atrophy in the body of the organ. The accompanying radiograph (Fig. 1) of a normal human spleen (postmortem) illustrates the distribution of the branches of the artery as it subdivides at the hilum. The result in all of our work on animals has apparently been atrophy rather than a rapid necrosis. The former might be secured in the human subject in a fairly small spleen, especially if enveloped in the omentum. The temperatures of the dogs were not observed nor was the blood pictures. Some of the dogs survived the secondary operation of removal of the atrophied organ and omental covering.

SUMMARY

The successful conclusion of the one human case and the experimental work on animals are not sufficient as yet to admit the operation as one to be recommended. To my knowledge the operation has never before or since been performed on the human subject. The operation will never supplant splenectomy. The latter however still has a very large mortality in the hands of most surgeons. Ligation of the artery may prove to be a safer procedure in selected cases.

week. A two of his dogs died within a few hours from shock and hemorrhage; the operative technique is open to question. He has also noted that in the dogs which recovered the omentum was firmly wrapped about the spleen. We have observed this in all of our cases. In a second series of 5 dogs he wrapped the omentum about the spleen after ligating the splenic pedicle and the dogs recovered.

Our work was confined to ligation of the artery alone; the vein alone (a considerable distance from the spleen) the arteries and vein and part of the artery. The results were uniform at secondary operation in

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RETROPERITONEAL CYSTS OF WOULFIAN ORIGIN

BY J. M. MAURY, M.D., F.A.C.S., MEMPHIS, TENNESSEE

MRS. A. R., age 36, white, married 17 years, entered Memphis General Hospital April 19, 1916.

Her family history and previous personal history have no bearing on the present condition as she is unaware of the presence of any tumors or growths in her antecedent.

Menstruation began at the age of 11 and has recurred regularly except during pregnancy and the puerperium. The period recurs every 25 to 30 days and lasts 4 days. Her last menstruation was April 12 to 15. She has had two children, age 13 and 12 years respectively, pregnancy and labor both being normal. For the past 15 months she has had frequent micturition, the bladder being emptied every hour or two both day and night. She came to the hospital on account of the presence of enlargement of the abdomen which was first noticed in the left lower abdominal zone a little over a year ago. Since its appearance the mass has continued to increase in size.

Physical examination. The patient is healthy looking but rather thin. Examination of the thoracic organs, lymphatics, nervous, muscular and circulatory systems and breasts reveal nothing abnormal. Several examinations of the urine revealed nothing abnormal except an occasional trace of albumin. Wassermann was negative. Blood normal. The abdomen is filled with a globular, fluctuating tumor reaching from the pubes to costal margins. There is central dullness and dullness over the left side of the tumor. There is a tympanic note above and to the right side. In her first labor the perineum was torn into the rectum with resulting inability to control flatus and liquid stools. Cervix normal, uterus normal and anterior to the tumor which could be felt per vaginam.

The preoperative diagnosis was proliferous cyst probably springing from the left ovary with complete laceration of the perineum.

Operation April 26, 1916. The perineum was repaired after the method of Emmett. A median abdominal incision revealed the fact that both ovaries were normal and that the tumor had no attachments in the pelvis. Enlarging the incision and examining further showed a smooth, glistening, pearly thin walled cyst having its origin posteriorly to the peritoneum in the gutter to the left of the spine. The whole lumbar gutter was filled with the cyst from up on the lateral abdominal wall to the spine and from above the kidney

to the level of the promontory of the sacrum. There was no umbilicus of a pedicle. The colon descended to its outer side. Enucleation was rapid and easy, care being taken to avoid the vessels going to the colon and it was soon seen that the cyst had no connection with any organ. When enucleation was nearly complete the cyst was ruptured discharging a clear, thin, watery fluid with a slightly amber tinge.

In the enucleation of the lower pole of the cyst a structure was encountered which was thought to be the ureter. Tracing it up, however, it was found to spread out and lose itself in the cyst wall and tracing it down showed that it did not go into the pelvis at the right place. Cutting this across revealed its structure to be tubular and a uterine sound put in the proximal end went into the cyst cavity. Dissecting out the distal portion showed it to go under the sigmoid and out into the broad ligament with and a little below the ovarian vessels ending in the broad ligament about halfway between the uterus and the pelvic wall. There was left after removal of the tumor a large denuded area which was drained from behind and covered in front by suturing the peritoneum over it. Convalescence was normal, the patient being discharged from the hospital in two weeks.

Pathologic report. Macroscopically the specimen consists of a tube 25 centimeters long and a unilocular cyst whose capacity it is difficult to estimate but which would hold approximately 1000 cubic centimeter of fluid. The tube is 1 cm in diameter, the wall being 1 cm thick. Microscopically it is made up of fibrous tissue arranged in bundles and lined with a single layer of columnar epithelium (Fig. 2).

The cyst wall is of variable thickness from very thin to 2 or 3 centimeters. Where an epithelial lining is present it is columnar or cuboid. The middle layer contains involuntary muscle fibers (Fig. 3).

Sections from different portions of the thick parts of the wall show the presence of the tubules (Fig. 4) and glomeruli (Fig. 5). The tubules are lined with cuboid epithelium (Fig. 6). One glomerulus (Fig. 7) is apparently well developed, the capsule and glomerulus being complete.

On looking up the subject of retroperitoneal cyst there is found a condition of considerable confusion. The textbooks which contain any reference to them and there are very few, limit the subject with the statement that retroperitoneal tumors do occur and may arise from kidney, suprarenal, pancreas and fatal result. The case reported are mostly from foreign countries, only four being from this country. Etiologically in a definite way the origin noted above they have been ascribed to many places, viz.: (1) lymphatic (2) and the result of traumatism (3).

It is often impossible to determine the origin of the cyst without a microscopic study has been made because wolffian cysts in their growth may either grow into or be developed underneath the capsule (4) of the retroperitoneal organs so that it may be necessary to remove the organ with the cyst.

In studying the literature one finds that the kidney, pancreas and suprarenal may give rise to cysts with certain histological characteristics but otherwise cysts arising retroperitoneally are practically all basically the same histologically, yet how certain wide differences can easily be accounted for will be shown under the section on histopathology.

Thus in all we find the fibrous cyst wall lined with epithelium which is found in the wolffian body, i. e. columnar ciliated or cubical in many canaliculi and glomeruli (4). One also struck with the number the content of such a hyaline colored foam admixture of blood elements and while knowing this to be possible in any cyst it occurs frequently in cysts in this locality a fact which is a valuable indication to etiology.

In the case the report of which is herein published a tube larger than a ureter communicating directly with the cavity of the cyst running downward passing under the sigmoid and terminating in the region of the normal parovarium could certainly be nothing other than a wolffian remnant, i. e. the wolffian duct.

The only similar structure developed in this region which might possibly exist as a fatal remnant is the muellerian duct. From the muellerian duct a well known developed

a fallopian tube, half of the uterus and half of the vagina. As all of these organs were in a condition of normal development which means the conception or utilization of this structure it could not have existed in its fatal or undeveloped condition and location. In addition the demonstration of the presence of at least one complete and many incomplete glomeruli and many tubules in the tumor wall finally and completely settles the nature of this particular cyst. Therefore one is forced to the conclusion that all retroperitoneal cysts not arising from retroperitoneal organs are genetically wolffian.

It is misleading because incorrect to class all retroperitoneal cysts under the name of retroperitoneal cyst and as all cysts arising from organs should have a nomenclature in conjunction with that organ (i. e. pancreatic cyst, suprarenal cyst, etc.) would it not be better to reserve the name retroperitoneal cyst for those of wolffian origin or do away with the name altogether and call cysts of wolffian origin wolffian cysts.

Kroenig gave to Roth the distinction of first having pointed out the true etiology of these tumors, his article having been printed in Virchow *Archiv fuer pathologische anatomie* 1881, lxxxvi, 371.

For a complete understanding of the character and location of the cyst, one must recall the development of the wolffian body in the lumbar region, the transformation and migration of its component parts and the regression or atrophic changes to which it is subject.

As is well known in man all of it is utilized while in the female it exists almost entirely in an atrophic unutilized condition. As has been pointed out this accounts for the greater frequency of occurrence of the cysts in women, only two of the cases reported occurring in men.

WOLFFIAN BODY

The wolffian body or mesonephros is developed from a mass of mesodermic cells, the wolffian ridge, which join the paraxial mesoderm with the lateral plate. From this mass of cells is formed the pronephric or wolffian duct which passes downward and

opens into the cloaca into which also opens the primitive bladder and the primitive intestine

While the duct is forming the cells of the wolffian ridge by a process of segmentation are arranged into a series of solid columns or cords which lie transversely to the pronephric duct each column being termed a nephrotome. Subsequently by a rearrangement of cells the nephrotomes become transformed from solid cords into tubules and open into the duct which is thereafter called the mesonephric duct. The duct is fully developed by the seventh week of fetal life and lies parallel to the primitive vertebral column and behind the parietal layer.

The free end of each tubule becomes invaginated by a capillary artery from the aorta develops a Bowman's capsule and forms a glomerulus. At this time the function of this organ is that of a kidney. This function in man however is but temporary and is taken over later by the permanent kidney. Retrogression of the glomeruli begins in the eighth week the lower series of transverse tubules becoming atrophic while the upper has to do with the formation of the sexual segment. From the lower end of the pronephric duct by a process of budding the ureter is formed growing upward to the nephrogenetic tissue from which is formed the permanent kidney.

During the development of the wolffian body the duct of Mueller of uncertain origin is formed lying parallel with and to the outer side of the mesonephric duct. From the duct of Mueller is subsequently formed in the female the vagina uterus and fallopian tubes while in the male it becomes atrophic. At about the same time the mesothelial cells undergo proliferation forming the genital ridge from which is developed the indifferent sex gland. The indifferent sex gland becomes differentiated later into the testicle in the male or the ovary in the female. The undifferentiated sex gland lies in close relation with the upper or sexual series of transverse tubules of the wolffian body.

In the male the sexual series of transverse tubules forms the excretory ducts of the testicle while the upper part of the meso-

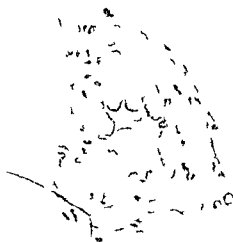


Fig. 1. Low magnification of transverse section of the duct to show arrangement of fibrous tissue bundles.

nephric duct forms the body and tail of the epididymis and the lower portion becomes the vas deferens. The lower atrophic series of transverse series of tubules remains in the form of the paraididymis. In the female the wolffian body atrophies and remains as vestigial structures only. The upper series of tubules is represented by the hydrotid of Morgagni the middle series with the adjacent portion of the mesonephric duct by the paramedian organ of Rosenmueller the lower series is the paraophoron and the unused portion of the duct as the duct of Gartner.

In the formation of the ovary there is a thickening of the mesothelial cells on the peritoneal surface of the genital ridge and a proliferation of the primitive mesodermic or connective tissue underlying them. The mesothelial cells which form the germinal epithelium penetrate the mesodermic tissue in the form of cords and eventually form sexual cords or egg columns from which are formed the graafian follicles. The medullary substance of the ovary is formed by the growth toward the egg columns of cord like processes of the epithelial walls of the glomerule of the primitive kidney or wolffian body. These cells exist in the mature ovary as the interstitial cells distributed through the connective tissue stroma of the ovary.

PATHOLOGY

In the description of the various specimens recorded in literature all of the component parts of the wolffian body — glomeruli, chi-

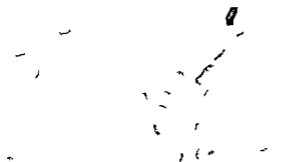


Fig. 3. Dilated duct lined by columnar epithelium. The duct is surrounded by a fibrous wall and contains glomeruli and tubules. The surrounding tissue shows signs of degeneration.



Fig. 4. Simple cyst lined by flat cubical columnar and ciliated epithelium. The cyst contains a watery fluid. The surrounding tissue shows signs of degeneration.

ated epithelium columnar cubical epithelium wolffian tubule and wolffian duct have been found. Albarrin demonstrated the presence of involuntary muscle fiber in the cyst wall.

The variety of finding as shown by cases reported manifestly due to the neoplasm arising in one of the many portion of the wolffian body. A dilated duct simply shows columnar epithelium lining a fibrous wall and the presence of glomeruli and tubules is a chance condition the result of failure of these structure to atrophy.

It is maintained by Recklinghausen that ciliated epithelium is found only in the middle section of tubule hence only in certain cyst wall the ciliated epithelium be found.

In the report Mauchair (4) the middle zone of the cyst wall contained crinoidal representing uriniferous tubules and rudimentary glomeruli. Yet he distinctly asserts that the tumor was not part of the kidney and that that organ was not removed with the cyst.

Pathologically the tumor are found to exist in the form of (1) simple unilocular cyst and (2) multilocular cystadenoma. The unilocular cyst are composed of a cell wall of fibrous tissue having an epithelial lining more or less complete. In Albarrin and in my case the presence of smooth muscle fibers are noted. Also in the cell wall has been found tubule of various size and shape varying with the angle at which they were cut all lined with columnar epithelium. The epithelium lining the cysts has been described as

flat cubical columnar and ciliated. The contents of the simple cysts a watery fluid clear or more often chocolate from admixture with blood elements usually containing cholesterol. The simple cysts do not seem prone to malignant degeneration.

The multilocular cysts appear in two forms graphically described by Moore as (1) A primary cyst of considerable size with numerous smaller cyst embedded in its wall and projecting into its cavity. (2) The whole neoplasm may be made up of a mass of cysts varying in size but no one of which may be designated as the parent cyst (1, 2). Both varieties have a wall of dense fibrous tissue with an epithelial lining which may however show a papillomatous formation. The contents of the cavities thick viscid or jelly like in consistency opaque or chocolate colored and in composition pseudomucinous or colloid. They are prone to malignant degeneration with the usual result. One case (Brown and Brady 10) had two metastatic foci in the lung and one in which the cyst had ruptured intraperitoneally (26) there was the so called peritoneal metastasis with a cysts as is commonly seen in papillomatous cystadenoma of the ovary.

It has been seen that the epithelium lining the transverse tubule of the wolffian body take on a higher development than the epithelium lining the duct acting in a glandular capacity while temporarily functioning as a kidney. It has therefore been suggested that the simple cysts arise from the



Fig 5

Fig 5 A group of gomeruli in the cyst wall

Fig 6 Transverse section of a tubule with lining of cuboid epithelium



Fig 6

Fig 6
Showing completely developed capsule and glomerulus



Fig 7

Fig 7
Showing completely developed capsule and glomerulus

wolffian duct while the adenomatous tumors arise from the tubules. This is apparently substantiated in my case.

One curious thing which has been pointed out by Jacquot and Faurissé is that these tumors although congenital do not show up until many years after birth. Albarrán is being the only infant.

LOCATION

It has been seen that normally there are no wolffian remains left above the pelvic brim but from errors which may occur in development and migration remains may persist in such location that in the event of subsequent development it may find itself between the layers of the mesentery between the layers of the mesocolon in the region of the kidney or even in the region of the cul de sac of Douglas (15) and later may occupy such positions as are determined by its primary location and the direction of its growth.

Jacquot and Faurissé assert that certain remains of the wolffian body do not accompany the sex glands in their migration but remain at their primary place in lumbar and retroperitoneal positions. The colon may be to the outer or to the inner side of the tumor. The kidney, suprarenal glands and spleen may be slightly adherent or so attached that all or part of the organ must be removed with the cyst.

Agguere and Oliver found it necessary to remove the kidney. Maclaure found the tumor adherent to kidney and suprarenal

but easily separated therefrom. Because of their greater powers of proliferation and their tendency to malignant degeneration the multilocular cysts are the most destructive in their growth. They form inseparable adhesions to parietal peritoneum and encompass and grow into juxtaposed organs.

SYMPTOMS

Most cases reporting for treatment came because of the presence of a tumor which if large enough produced the mechanical symptoms incidental to abdominal cystic neoplasms. In two cases jaundice had occurred though its etiological relationship to the tumor was not made clear. It was possibly coincidental. Also in one case several attacks of renal colic served as a misleading factor in making the diagnosis. In the advanced cases with malignant degeneration there was the usual loss of weight and cachexia naturally to be expected from malignancy.

TREATMENT

The necessity for complete and early removal is evident. Aside from the unlimited growth which is an inherent attribute the tendency to malignant degeneration renders early removal imperative.

In one of the cases in which the kidney was removed with the tumor the description of the relation of the tumor to the kidney would lead one to infer that with a more accurate knowledge of the nature of the tumor the kidney might have been saved.

panying such a localization particularly phlegmon of the ligament, peritonitis and septic pyæmia

Recently there is again silence and a few lines only are devoted to it in the texts under chapters relating to puerperal infection

It needed only the direct active struggle of the German gynecologists Freund Trendelenburg and Bumm against thrombophlebitis to cause attention again to be focused on its modern symptomatology. In fact the operations proposed and carried out by these surgeons require a perfect diagnosis in order to justify venous ligature and such diagnosis must be sufficiently early in order that the desired results may follow the operation. At present the matter may be put thus: Does a precise symptomatology of uterine thrombophlebitis exist? Is there an anatomopathological and clinical condition which justifies venous ligature? Do satisfactory results follow?

We give here the clinical history of a case which has suggested the considerations which will be referred to later

Service of Maternal Protection No 1713-365, Saturnina I de A 40 years old VIII para entered March 21 1917 all pregnancies and labors normal 2 twin pregnancies menstruation regular since sixteenth year. Medical examination shows only a slight systolic murmur at the heart apex numerous varices urine shows no great diminution of chloride (234 ctg) and 0.10 grs of albumin with nothing abnormal in microscopic examination

On entrance it was found that she had been normally delivered March 10 but that the placenta was expelled after 5 hours under the action of some unknown drug. There appears to have been some slight hemorrhage. About March 15 or 16 her left leg which during the pregnancy had caused her much pain again became painful the pain extended as far as the renal fossa on this side and was accompanied by a pronounced chill. Examination shows the left external saphenous enlarged and painful as also is the kidney region on the same side. Diagnosis of phlebitis is evident and iodized alcohol applications were ordered with immobilization of the limb

March 21 and 22 complete apyrexia. On the evening of the 3rd the temperature rose to 39.4 without a chill falling to 37.5 the following morning. Renal and abdominal sensitiveness have completely disappeared. March 25 Temperature 37 in morning at 3 p.m. chill lasting 15 minutes bringing the temperature to 41 and the pulse to 140 which on the previous days had oscillated between

86 and 120 according to the temperature. March 26 The general state is excellent there only persists some pain in the left iliac fossa. Temperature 37.5 to 38.3 pulse 100 to 108. March 27 Temperature 38.4 to 38.6 Pulse 112 to 120 same findings. March 28 Temperature 36.6 at 6 a.m. at 10 a.m. chill lasting fifteen minutes temperature 38.5 pulse 112 at 3 p.m. new pronounced chill temperature 40.4 pulse 140

March 9 Temperature 39.3 pulse 120 at 8 a.m. The patient was examined and the uterus was found mobile in anteversion and slightly in ante flexion normal involution. No Hegar's sign adnexa not palpable. In the thickness of both ligaments venous packets were clearly felt slightly sensitive and free in the cellular tissue the lesion predominates to the left there is no infiltration of parametrium. In the evening temperature 37.4 pulse 104. Forty cubic centimeters of anti-treptococcic serum was administered. Blood culture was negative. Temperature oscillated between 37 and 39 and pulse from 92 to 116 without chills. The general state was good. Locally the edema of the left leg increased moderately. Immobilization and the iodine applications were continued. Ten milligrams of sublimate were administered daily intravenously

April 4 Morning temperature was 36.6 and the pulse 96 but in the evening the fifth chill occurred bringing temperature to 40 and pulse to 146. The general state seems depressed. April 5 Morning temperature 36.6 pulse 92. In the evening of the 6th chill with 41 and pulse 136. A new examination on April 6th confirmed the signs observed. March 29 bilateral juxta uterine thrombophlebitis without peritoneal involvement. It was decided to operate and the patient was prepared accordingly

April 7 operation. Operator Doctor Turenne Assistant Dr. Colistro. Anæsthetic Nurse Bruno. Morphine pre-operatively. Anæsthetic ethyl chloride ether. Extreme Trendelenburg position. Wide Pfannenstiel incision

On opening the abdomen the peritoneum was found intact without adhesions or exudates of any kind. The uterus was more than double its normal empty size it was reddish in color and without signs of perimetritis it was slightly displaced to the right. The right adnexa were normal. In the thickness of the broad ligament on this side and about its base a thick cord was observed corresponding to the thrombosed uterine vein. Nothing abnormal was noted in the zone of the spermatic. The adnexa on the left were healthy a vascular packet was seen to originate from the mesosalpinx occupying the cellular space of the broad ligament fairly hard in consistency in particular a vein as thick as a lead pencil thrombosed and moniliform the thrombosed extended into the spermatic zone as far as the pelvic wall. No infiltration of the cellular tissue was observed and the edges of the broad ligament glided over the thrombosed veins

Owing to the localization of the lesions I decided

to ligate the hypogastric vein on the right and the
on the left

About the level of the posterior and 3 centimeters to the right of the posterior median line I made a vertical incision of 4 centimeters in the peritoneum. The external lip of the incision was drawn out, displacing the ureter and the perivascular sheath. The incision was distensible from the artery, was denuded and ligated about centimeter beneath the bifurcation of the left iliac vessels.

The incision on the left was made 4 centimeters from the posterior median line by separating the abdominal wall and the median line of the vessels. There was a length of 10 centimeters in the same way on the right. Finally, the specimen was made the ligament of the pelvis. As the stitch passed through the thickness of the abdominal wall, there was a little bleeding, a fine line was placed in the abdominal wall by the ligament of the sigmoid colon.

After the operation, the patient was placed in the supine position. The temperature was 38.2 to 38.5. The pulse was 92 to 100.

After this the patient's condition rapidly improved. Between the 4th and 5th days the temperature suddenly rose to 39.5. A painful multiple peritumescence appeared. However, as this coincided with the rapid development of the fistula abscess, this was incised in the thigh. Locally, the venous packet on the right was found in the same state and that on the left was ligated but not palpable.

After April 8 the fever disappeared and the signs of phlebitis of the lower left limb became less and less. Microbiological cultures were negative and the pus fluid was not accessible.

The patient's convalescence was interrupted by a limitation into catarrh causing some slight fever, which yielded to a purgative.

On May 1 a union showed the uterus in light retroversion and painless. The right sciatic plexus was much reduced, however, a thin string could be perceived, which represented a thrombosed small vein of the pelvic plexus. No ascus cord was noted on the left and lack of elasticity of the broad ligament only persisted.

The patient was out of bed on May 10 and left the clinic completely cured early in June.

Before entering into the study of thrombophlebitis we may glance at the ideas concerning it currently accepted by gynecologists. However, these opinions are not sufficiently well known to the general practitioner and the opportunity of intervening efficaciously at the proper time is sometimes lost.

Unquestionably pregnancy and labor favor

the development of venous lesions. Putting aside the aseptic thrombosis which accompanies the genital involution of the puerperum, there is a large group varying from the simple varicose phlebitis of pregnancy to the severest postpuerperal infectious thrombophlebitis. During pregnancy we meet the same conditions as are found in experimental pathology which are necessary to provoke the venous lesion and its thrombotic consequences: modifications in the blood represented by increase in the number of platelets particularly at the end of pregnancy and after the discharge of the secundines; notable when these are concomitant with a poor general condition, acute anemia, septic states, disturbances in the circulation after the modifications which the pregnancy imposes on the pelvic circulation in veins which by their particular situation normally diminish the velocity of the current, penetration into the circulation during the whole cycle of the pregnancy of the numerous foreign substances originating for maternal defense against ovular poison of all more or less transformed products of foetal metabolism of the toxins arising from defective functioning of the organs of elimination. If to these we add the impossibility of an ideal asepsis of the genital organs, the great frequency of an active microbian flora in the cervical and more especially in the vaginal lochia at a time when the puerperal lesions are in a state of repair, we find united in full proportion all the necessary and sufficient factors for a venous contamination of the genital zone.

Such considerations make us think that despite the silence of many classical texts, puerperal thrombophlebitis is not a rare condition. Systematic and repeated examination of all puerperal infection cases has permitted us frequently to observe the physical signs of venous infection.

Pathologic anatomy as well as the clinic demonstrate that the venous lesion is a complication. Either the organism defends itself sufficiently and in a short time all is restored to order or the parametrium, the adnexa, the peritoneum and the veins of the lower limb become involved and the thrombophlebitis passes to the second stage without

danger of giving place later to the clinical picture of pyæmia

Owing to this combination and alteration the symptoms proper of thrombophlebitis may pass unperceived and even with reason cause many to doubt its existence as a clinical entity

Side by side with these complex cases are others more numerous which frequently pass unnoticed because the focus of infection is discovered is taken care of without further trouble Thus are left a reduced number of cases in which the venous lesion predominates and gives its special aspect to the evolution of the disease

Thrombophlebitis is generally confounded with pyæmia with which it has many features in common and in which it frequently terminates but there is a period long in some cases in which the lesion is localized or progresses very slowly giving only occasional microbial or toxic signs which the organism sometimes resists for weeks

We ought therefore devote all our attention to the knowledge of this period since once passed we are powerless to combat with the generalized infection

According to Michaelis slight prephlebitic rises in temperature are of great value I attach great importance to this sign observing however that the axillary temperature is extremely fallacious But I think that a sign which I have never seen before described is of much greater value Since 1906 I have observed that in that period which for convenience we will term prephlebitic (although adnexial phlebitis exists) there are early *rectal thermic increases* coincident with axillary apyrexia This local hyperthermia which may accompany the initial pelvic process is a very early phenomenon since I have observed it four five and even eight days before the first axillary indication of fever I think it is a sign much more valuable and constant than Mahler's pulse sign

The early rectal increases have so much the greater value as hæmorrhages are frequently accompanied by peripheral hypothermia during the early days But later when thrombophlebitis is established the curve is absolutely characteristic From apyrexia or a sub

febrile condition increases in temperature are observed at irregular intervals of one two even ten or more days which reach at times 40.5° 40.8° 41° or even 41.5° These accessions are not accompanied by either considerable or permanent changes in the pulse If the pulse does rise to 140 150 or 160 it is only during a chill and falls again with the temperature

A sign worthy of mention is that other puerperal localizations uterine adnexial parametrical and especially septicæmia are accompanied by a higher and a more permanently high pulse than thrombophlebitis

The study of repeated blood cultures has given me interesting results In thrombophlebitis I have found cases always or temporarily positive in the hours following chill Outside of this the persistence of a positive blood culture is to me a sign of transition to septic pyæmia

In forms purely localized I have found no serious uterine changes nor generally in the greater part of the organs and apparatus I except the lung alone in which an embolus is not rare I have never seen a fatal embolus due to pure septic thrombophlebitis

Locally I think that the signs in simple cases are clear and precise and in this I disagree with Wallich's suggestion which was mentioned at the beginning of this article and the results of the discussion held in the Society of Obstetrics and Gynecology of Paris In that type of thrombophlebitis which is called precocious I have generally found the uterus increased in volume soft mobile and at times slightly painful The adnexa are either not perceived or are normal The signs may be reduced to a want of elasticity in the thickness of the broad ligament a slight sensitiveness which contracts with the hyperalgesia of adnexitis or the adhesive matting of parametrial infiltration

Generally the signs are very clear At one time we can feel in the base of the broad ligament or in its thickness and following its upper border a hard moniliform string more clearly in the vicinity of the uterus than toward the pelvic wall At another time the classical packet of varicocele which is unmistakable is palpable

The precision of the contour of the thrombosed vessels allows differentiation of them from intraligamentary hematomata which systematic examination of normal puerperal cases has demonstrated to me are rare.

In some cases other thrombosed vessels can easily be perceived especially in the prevesical space and in the thickness of the vaginal walls with the exception of one case terminated by a retropubic phlebitic abscess all other cases thus located terminated by resolution.

That the patient remains in excellent general condition for some time is noteworthy; the appetite is good and sleep is not disturbed; a cheerful optimism possesses the patient and spreads to all who attend her. Many gynecologists have therefore remarked the surprise and incredulity with which the consulting physician receives their somber prognosis. In reality this apparent resistance which contrasts with the alarming rises in temperature is a characteristic of the clinical picture of thrombophlebitis in the localization period. It is only later on when the general circulation swarms with streptococci or when multiple abscesses stud the viscera that the signs of rapid aggravation appear. Hence the clinical progress and the results of the physical examination give sufficient evidence to solve affirmatively the problem of the existence of pelvic thrombophlebitis.

If we are to judge by published statistics the prognosis is excessively grave; a mortality of 50 to 60 per cent is alarming. My impression however is that this mortality is exaggerated and I am convinced of this because of the relative frequency in which signs of thrombophlebitis exist and still the cases terminate favorably. And not alone the precocious cases so terminate. My colleagues Drs. Infanzozzi and Colistro in the Annual Meeting of the House of Maternity reported extremely grave cases ending with recovery. In the first of these the lesions were so extensive that the abdomen was opened in order to attempt venous ligation which was abandoned; the patient recovered and shortly after again became pregnant. But it is unquestionable that in cases where the febrile curve reaches the type described the mortal-

ity is high. All attempts made: local uterine treatment, vaccine sera, sublimate and various colloids administered frequently in travenously have been failures and the disease has advanced to some visceral localization, thrombosed extensions of the inferior and superior cavæ or have terminated by septicopyæmia.

I have purposely omitted the fixation abscess from the methods of treatment. In fact Fochier's method, the efficacy of which is exaggerated by some and disputed by others, has not from the therapeutic point of view given us convincing results; however we have never employed it alone and the results must be placed to the credit of the general method of treatment of puerperal infections. But if its therapeutic value is discussible its prognostic value has become fixed in our service. In cases where there is a positive reaction a fatal evolution is so exceptional that in all grave cases we employ the subcutaneous injection of essence of turpentine as a method to learn early of the eventual progress.

In cases which appear contrary to experience a new provoked abscess generally negative or of very torpid evolution explains the apparent failure of the method. I remember only one contrary case: a woman in whom I amputated an enormous hypertrophied uterine cervix with prolapse at the end of the pregnancy and in whom a rapidly progressive gangrene demanded intervention. In this woman the abscess was positive. Even within the presence of co-existing articular and tendinous suppurative localization, the sign of a thrombophlebitis accompanied by early pyæmia, the case terminated by extensive thrombosis of the two *enacæ*.

Because of the high mortality in such cases we were induced to operate in the case which we report as the indications were sufficiently characteristic to warrant intervention and we hoped from the results to make deductions which might help to settle a question which up to the present time had not been definitely solved.

What should be considered a basis for surgical intervention? Experiments made in the past have shown the possibility of checking the septicophlebitic process by ligation at a

point sufficiently removed from the thrombus to insure against injury to the wall of the vein. A very recent article by MacLennan (1915) proves that no matter what is the condition of the ligated vessel coagulum is always formed in the distal part of the vein. This author has shown also that the blood between the ligatures is rapidly absorbed leaving in its place a fibrous cord.

Otologic experience justifies ligation of the jugular in septic cases and it was this experience which in 1895 induced Freund to propose the ligation of thrombosed veins. Trendelenburg and Bumm performed this operation but a sufficient number of cases has not been reported to date to render new data unnecessary.

K. I. Sanes in an article read before the American Association of Obstetricians and Gynecologists reported 12 cases published up to September 191 with 64 deaths or 52.5 per cent which is the percentage generally admitted. The same author makes note of 752 cases of thrombophlebitis not operated on with 395 deaths or about 51.6 per cent.

Since then I have found in the available literature 17 new cases.

Authors	C	Rec	D	h
Huggins	4	3	1	
Brown	2	2	0	
Jellet	5	3		
Baldwin	4	3	1	
Fromme	1	0	1	
Turenne	1	1	0	
	17	12	5	
	Percentage 29.4			

Fromme's fatal case a primipara with post abortive infection was extremely grave and thus certain to failure. He found a complete thrombosis of the primary right iliac vein as far as the lower vena cava about 2 centimeters from the bifurcation the left side was healthy. He ligated the vena cava 3 centimeters above the thrombus. The temperature fell for ten days chills then set in and the patient died three weeks after operation. Autopsy showed that the thrombosis had invaded the iliac on the left side.

All authors do not favor intervention but judging by the cases published there is a

notable improvement in the operative prognosis during recent years. Palmer Findley analyzing 7 cases of varied evolution is opposed to operation for the following reasons: (1) that the lesion cannot be demonstrated by laparotomy even if the fever curve is characteristic; (2) that if the lesions are situated very high nothing susceptible of ligation is met in the zone; (3) that infection may continue its invasion in spite of the ligation. Although his arguments are of some value in face of the very serious prognosis of thrombophlebitis yet none of them is sufficient to lead us to therapeutic nihilism.

It is of interest to point out the contra indications to intervention as it will serve to dissociate a series of cases which uselessly swell the statistics giving a false percentage of mortality thus preventing some operators from using a therapeutic method which may benefit many patients.

In my opinion venous ligation is indicated —

1 In cases in which the septic venous lesion is directly diagnosed and there is no persistent bacteremia between the chills.

When the genital and general clinical examination does not show any septic visceral foci which indicate generalization of the infection utilizing from this purpose all present day laboratory methods (leucocyte count, biopsy, roentgen diagnosis, etc.).

3 In cases in which direct examination gives doubtful results but where the clinical progress is characteristic.

Ligation is contra indicated —

1 In cases of persistent bacteremia or confirmed septicopyæmia.

2 When there are predominant uterine or juxta uterine lesions (adnexial parametrial, peritoneal). Doubtless in many cases while not proceeding to ligation or holding a doctrinal conservative position laparotomy will afford a favorable solution of certain clinical and therapeutic problems.

This is the course of conduct which we advise should be followed until more extensive reports enable us to modify or ratify our ideas.

Technique. The most suitable method of procedure may be effected by three routes

the extraperitoneal the vaginal or the transperitoneal

The *extraperitoneal route* is used by Trendelenburg, Von Herff and Lenhartz is theoretically the least dangerous since it obviates peritoneal contamination. The following objections to this route may be made

1 It permits only half of the pelvis to be approached for each incision

2 Peritoneal protection is only relative if the thrombosed vessels are not easily accessible

Owing to the difficulty of exploration it frequently happens that uninvolved vessels are ligated and those that are really thrombosed are not perceived. Moreover maneuvers are made exclusively under tactile control which explains why operators of repute have ligated a tumor mistaking it for a vein.

4 The incision does not allow easy and complete exploration of the juxta uterine region which may show the necessity of complementary operation or contra-indicate venous ligation.

5 Finally this route probably for the reason above has given the highest mortality.

Intral route. Without being opposed to the vaginal route I do not believe that it is ideal. It is evident that it reduces the traumatism to the minimum and it cannot be denied that some of the pelvic veins can be ligated by it. However I think that there are two capital objections: (1) it does not allow the ligation to be made at the required point when the thrombus particularly if hypogastric is situated near the iliac junction and less so if it is in the primary iliac or in the inferior cava. (2) the maneuver necessary for inspection and venous ligation necessitate a manipulation incompatible with the justified fear of an easy fragmentation of the thrombus. Moreover for the case in which it is desired to make a venous resection or an evacuation according to Baldwin's method the peritoneal defense is greatly compromised. If to this is added the necessity of wide vulvovaginal approach we see the reasons why the vaginal route is rejected as a method of choice. Besides although the number of cases reported is few yet with the exception of Taylor and

Birmingham (3 cases with 3 recoveries) the mortality is high.

Transperitoneal route. For the surgeon accustomed to abdominal operations this is the surest and least objectionable method. There is little danger since habitual caution is observed and in case of meeting irreparable lesions the method permits closure of the abdomen without further inconvenience to the patient. The case of Infantozzi already quoted demonstrates its simplicity in the case of a patient whom he considered doomed.

This method is also rendered safe by adopting the extreme Trendelenburg position and the use of the Doyen and Faure retractors which give an ample field of inspection and a clear sight of lesions appreciable to view and touch permitting the intervention to proceed in the most rational manner.

The transperitoneal route alone facilitates high and complete ligatures which in pure cases like ours are simply matters of operative technique. This technique which we have described in reporting the cases and which is that recommended by Quenu and Duval in 1898 for bilateral ligation of the hypogastric artery prior to rectal resection obviates gross error such as that of Leopold in confounding the vein with the artery or that of Lenhartz in ligating the ureter.

Having decided to approach the veins by the transperitoneal route and assuming that the venous lesion has been found in order to simplify the discussion we may now proceed (1) by ligation (2) by resection (3) or by venous evacuation with or without hysterectomy and drainage.

1 *Ligation.* The majority of authors are content with ligation of the thrombus. It is the most harmless intervention and it has given the greatest number of recoveries. Doubt arises as to the height at which it should be made and the number of vessels which ought be included.

There is no doubt but that ligation of the inferior cava is dangerous however if we remember that the thrombus has already diminished its circulatory power we may suppose that the return circulation is already secured by collateral routes which normally have only a secondary importance. In the

rare cases in which it was done the absence of disturbances of this kind permits our acceptance of this hypothesis

Generally it suffices to make the ligature at the discharge point of the hypogastric without fearing for the reasons stated to execute it in the primary iliac. For the ovarian vein ligature will be made where it issues from the broad ligament which is generally free.

Ligature of the thrombosed veins alone has given good results but Fromme's case in which after a favorable remission the patient died by invasion of a vein noted as healthy at operation forces us to reflect as to the value of ligating the four principal discharge trunks of the genital zone: the ovarian and the hypogastrics. In this respect it is well not to forget a venous return described and figured by Kownatzky in his *Atlas The Veins of the Pelvis*. I refer to the median iliac which at times discharges into the primary iliac or in the cavity above the hypogastric and which is a carrier of the blood of the isthmus and superior regions of the uterus is capable of turning the germs of those infected regions into the general circulation.

Careful study of the atlas referred to more over shows the extreme complication of the pelvic venous network during the gravid puerperal state its irregular anastomoses and the necessity of high ligatures in order to prevent evacuation of the infected blood into the general circulation (Figs 1, 2 and 3).

2 *Resection* Resection is added to ligature in certain cases. The peritoneum undoubtedly is rendered liable to infection but it is not impossible to proceed as in case of suppurative adnexitis by protecting the vicinity of the operative field and resecting with the galvano or thermic cautery. Because of the good results of simple ligature — shorter and less traumatization — I think resection ought be reserved to cases of phlebotic abscess. Because of this I am inclined to think that great probability exists of invasion of the general circulation by the streptococcus and the mortality following cases of resection bears out this presumption.

3 *Evacuation* Baldwin in the *American Journal of Obstetrics* 1915 published a series of cases of thrombophlebitis treated as fol-

lows: Total transperitoneal hysterectomy isolation and ligation of the uterine trunks expression of the veins and evacuation of the conglobulum tamponade of the pelvis with iodoform gauze and wide vaginal drainage suture of the sigmoid to the pelvic wall in order to isolate the large peritoneal cavity. In all cases the uterus contained abscesses of various dimensions. In 4 cases operated on he lost only 1 by late pulmonary embolus.

This series gives a favorable impression although the technique appears somewhat brutal the frequency of uterine abscesses merits its being taken into account in the future. Up to now Baldwin is the only author who has followed this technique and a prudent reserve is the order.

In resuming we give our preference to venous ligation by the transperitoneal route. After the method of intervention has been decided upon there is still one important point left which up to now has not been decided. A thrombophlebitis having been diagnosed when ought we operate and what elements ought we take into account when judging between expectant treatment which gives 50 per cent or more recoveries or intervention which may give 30 per cent more?

The personal experience of individual authors is not at the present time sufficient to give clear indications that the question is still obscure for many gynecologists can be verified by questioning men of large experience. If we add that in certain schools the puerperal vagina is a *noli me tangere* it explains the many difficulties which a physician meets in endeavoring to formulate a firmly established rule of conduct.

The criterion of Bumm and other German authors who see the operative indication in the number of chills I consider to be unscientific. Neither the second nor the fifth chill should make us incline toward operation (1) because it is not rare that patients with intermittent lochiametritis show repeated chills if the uterus is not methodically drained and (2) since it is not rare that patients recover after 10, 15 or more chills.

It is lamentable that at the present time we have not in the opsonic index and other analogous methods the means of judging the

degree of resistance to infection the pyoculture of Delbet has not given any convincing results. We are forced then for the moment to be guided by careful clinical observations using such further methods as are available to show if the patient is losing ground under the weight of the infection and it is in such signs which are the only ones available that we find the indications to operate. Thus repeated blood cultures and finding the first invasion of streptococcus persisting for 24 hours add a great certainty in determining the moment of intervention. This determination is one of the matters which ought particularly be studied in the near future.

The extension which we have given to the operative phase of this subject ought not make us forget that though less brilliant other conduct can give results more favorable than major operations. I refer to the prophylaxis of thrombophlebitis. A series of well observed fact permit of the disposition of this question.

Thrombophlebitis is observed only exceptionally in the rich classes and then I have seen it always follow criminal abortion by professionals using septic instruments. Thrombophlebitis is generally the heritage of the poor those who are badly nourished exhausted auto-intoxicated those carrying for the greater part gonococcic cervical lesions varicose and genital prolapses those badly attended in their labors and in whom the uterine inertia of the secundines and its consequent hemorrhage are frequent those operated on late in the case of dystocia. With such patients it is no wonder that the statistics of thrombophlebitis are so great.

A retrospective glance shows us that in spite of this in the clinics to which these women come thrombophlebitis tends to diminish since it reached its zenith between 1885 and 1905. To what is this due?

In that period when obstetrics entered into the zone of action of the Listerian method prolonged and excessive repose was considered obligatory for the puerperal patient. But later as always happens the reaction led many gynecologists to the excessively early rising from childbed as proposed by the German School.

An appreciation of the facts has made us always partisans to early mobilization and getting the woman up. The brilliant results obtained by abdominal gymnastics in congestive pelvic processes have demonstrated early its use as a means of regulating the circulation. If we add to this that prolonged immobility tends toward disturbances of various organs particularly intestinal inertia a very important factor for microbic or toxic attack of the pelvic veins it will be understood why in my private as well as my clinical practice when the hours immediately subsequent to labor have passed I allow liberty of movements being guided as regards getting up by the progress of genital involution and the evolution of the puerperium. Intensive treatment of genital lesions and the rational treatment of gravid intoxications is based on the same prophylactic principle. With this object in view we have struggled in Uruguay and followed our objective so that the poor may be protected during pregnancy and meet labor strong and robust vigorous physically and mentally with the knowledge that their condition has been zealously watched as an efficient factor for strong and healthy future generations.

The supervision of the secundines and puerperium ought to be considered as important not only because of the necessity of asepsis but as a means of reducing to a minimum those physiological aseptic thrombi on which infections may be grafted.

We have purposely omitted from this article other types of thrombophlebitis which may be met in a gynecological practice. Although numerous points of contact exist between them and puerperal thrombophlebitis yet they have their own modes of appearance progress and termination the study of which is outside the scope of this article. Beside their history is so well known especially that of postoperative thrombophlebitis that interest in this study is at the present time much less than that of puerperal types.

CONCLUSIONS

1. There is a rational prophylaxis of puerperal septic thrombophlebitis.

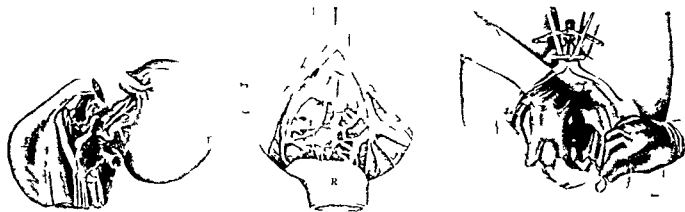


Fig. 1

Fig. 2

Fig. 3

Fig. 1 The veins of the pelvis cut from above. The extreme complexity of the venous system is found in puerperium. This section represents the left part of the pelvis with the patient in the Trendelenburg position. It encloses the pelvic space of the uterus and the right and left veins of the broad ligament injected and ligated (Korotkiy).

Fig. 2 Schematic diagram showing the pelvic venous system. The vertical black line indicates the peritoneal incision.

Fig. 3 The horizontal line indicates the line of ligature in the clinical practice (Korotkiy).

Fig. 4 Ligature of the hypogastric and the median iliac veins. The figure represents the operative field with the patient in the Trendelenburg position. It is necessary to bear in mind that it is not necessary to make the peritoneal retraction at all (Korotkiy).

Fig. 4 Chart showing the temperature curve.

Thrombophlebitis has signs, symptoms, and a clinical evolution which permit a diagnosis to be made in the majority of cases.

3. Although in more than half the cases there is a tendency toward subsidence and recovery, the high mortality justifies modern methods of treatment.

4. Surgical intervention, especially ligation of the thrombosed veins, is rational.

5. The transperitoneal route is the preferable one.

6. Ligation of all the efferent venous trunks of the genital zone is desirable.

7. Resection or evacuation of the thrombus should be resorted to only exceptionally.

8. The results obtained from direct intervention on the thrombosed veins should encourage new attempts at operations to fix definitely the field of operation.

9. Operations on the veins is contraindicated in cases of permanent bacteremia, in accessible thromboses and in cases of visceral pyemic localizations.

DEPARTMENT OF TECHNIQUE

LASTORHY OF THE BLADDER

A CONTRIBUTION TO THE TECHNIQUE OF THE LAPSAPRITONEAL OPERATION

B. C. COITMAN MD FAC S I M VA D I J WILKINSON MD H C T W VA

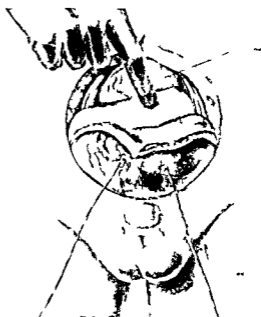
THE principle underlying the successful treatment of complete extraphysic the bladder include the familiar fact of normal plasticity of the wall of the bladder and the importance of the pathologic physiology of the upper urinary tract. An excellent treatment of the deformity by surgical means should be made into consideration not only the attack of mechanical hypostasis of the secretion from the kidney but also the protection of the renal from ascending infection. The recent development in the surgical treatment of malignant tumor of the bladder in the radical removal of the bladder in extensive malignant disease has given rise to the stimulus of the effect upon the kidney in case of transplanted of the ureter with the urinary tract of the bladder into the part of the large intestine. The technical methods of such transplantation have been largely successful but the preliminary to the subsequent health of the patient is rather for consideration of the individual properly selected only by careful study of patient after operation. Therefore

all such cases should be reported so that definite conclusion may be drawn as to the best method of handling of the secretion of the kidney when the bladder is undeveloped or in the case of extensive malignant disease.

For descriptive reference is necessary to the many ingenious plastic procedure which have been proposed for the relief of complete extraphysic the bladder. All attempts at the construction of a bladder from skin flap have only added to the annoyance of the deformity. An important advance in the surgery of this condition was made by Mayall in 1900 when he transplanted the body of the bladder into the sigmoid. This procedure however carried an almost prohibitive mortality from peritonitis.



The illustration shows the abdominal area with a large, irregular mass on the right side, representing a tumor or a surgical site. The mass is labeled with the letters 'A' and 'B'.



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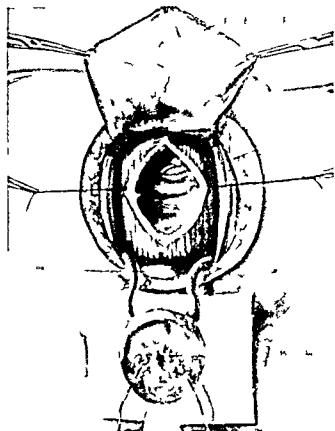


Fig. 3. Bladder flap completely detached. Incision in rectum parallel to tract of sutures. Peritoneal pouch removed from posterior surface of bladder in upper part of drainage.

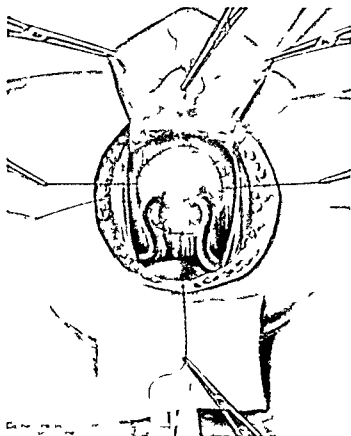


Fig. 4. Bladder flap sutured posteriorly and implanted into rectum. Peritoneal pouch held in place by a possible interruption of the ureter. Uteral catheter shown protruding from rectum.

In 1906 Moynihan transplanted the entire bladder remnant into the upper part of the rectum without opening the peritoneal cavity. This type of operation has met with considerable success in the hand of Moynihan, McGuire and others and was followed with slight modifications in the case herewith reported.

Presented male age 6 referred by Dr. W. W. Act of Clarksville, Virginia, July 1909. The family history is unimportant. The child's health as early as birth was fair but at the time he began to improve and apart from the bladder defect he became healthy and well developed. The bladder defect characterized by a small opening at the perineum. He entered the hospital at age 5, a man's dress account of the irritation to the external skin and mucous membrane caused by trousers. The defect was typical of complete exstrophy of the bladder. The skin around the exstrophy is a little thickened. The constant flow of urine over the parts. A hernia formed by the undeviated bladder which protrudes all beyond the plane of the anterior abdominal wall. The right ureteral orifice is plainly visible the left is covered by what has been under an apparent or error of the mucous membrane. X-ray examination showed a separation of the pubic bones. The penis is developed and furrowed along the dorsal surface. The anterior portion of the ureter is missing and the posterior part is continuous.

with the muco-membrane of the exstrophy. There was some induration of cutaneous epithelium around the bladder muco-membrane.

Physical examination revealed a bright healthy child despite the exception of the complete exstrophy of the bladder. There are no associated developmental lesions in the ureter. After careful treatment for a week during which time the patient received 1500 c.c. of the irrigated solution he persisted upon after the method of Moynihan.

Operation July 1911. The phallus and as the right iliac by an assistant and a ureteral catheter inserted into the ureter for 1/2 inch and fastened to the papilla with catgut suture. With the patient in the Trendelenburg position a median incision a male from 1/2 inch to 1 inch above the upper edge of the exstrophy to the muco-cutaneous junction. The incision was then carried to the right and left through the junction of the bladder with the skin. The peritoneal pouch was freed and under the median incision and peeled away from the bladder wall with dry gauze (Fig. 3). The bladder, particularly from the incision through the peritoneum of the bladder accompanied the top of the perit. An accidental rupture of the peritoneum immediately closed itself. The pubic attachment of the bladder is not hindered at this time in order that it then return to the bladder from which it be preserved with the rectum as exposure for the implantation of the detached bladder. The right ureter is placed in the ureter which is 1/2 inch from the top of the



ables a safer and more rapid dissection of the ureter but serve no useful postoperative purpose. They probably increase the tendency to infection of the kidney.

3. Prevention of postoperative hernia and reinforcement of anastomosis by utilizing the peritoneal pouch (Figs. 4 and 5).

The prolapsed bladder wall with the attached peritoneum constitutes a hernia. Interrupted sutures closing off this pouch from the general peritoneal cavity is analogous to the important procedure of high ligation of the sac in inguinal hernia. The distal portion of the double flap is used with great advantage to cover and

strengthen the anastomosis between the bladder flap and rectum. Leakage of the anastomosis causes complete failure of the operation for should the patient survive the infection the results will probably be an incurable urinary and fecal fistula. There seems to be no mention in the literature of the use of the peritoneal pouch as described above.

4. Thorough dilatation of the sphincter ani to prevent rectal distention. This should be done before the operation is begun and repeated just before the patient leaves the table. Free exit must be provided for the escape of gas urine and feces until union of the anastomosis is firm.

TRANSPERITONEAL NEPHRECTOMY IN INFANTS FOR LARGE CONGENITAL HYDRONEPHROSIS

BY M. S. KAKELS, M.D., ILLINOIS NEW YORK
S. GEORGE L. H. P. I. V. T. G. S. R. K. J. B. H. H. P. I.

IN March 1916 I reported a case of unusually large congenital hydronephrosis in an infant six weeks old. An anomalous congenital condition of the ureter was found to have obstructed the outflow of the urine. In view of the fact that recently I had occasion to operate on another case of stricture of the ureter in an infant ten months old I thought it might be of interest also to report this second case of transperitoneal nephrectomy for an hydro ureteronephrosis even if only as an illustration of another form of congenital obstruction of the outflow of urine from the kidney. In both cases the ureteral stricture gave rise to physical signs suggestive of an hydronephrosis but only at operation was it clearly established that in one a congenital faulty insertion of the ureter at the ureteropelvic junction was the cause of the hydronephrosis while in the other the hydronephrosis was the result of a congenital stricture of the ureter at its lower end close to its vesical insertion.

The first case of hydronephrosis in the infant six weeks old of the type where the congenital occlusion was found at the ureteropelvic junction was published in the *New York Medical Journal* for March 18 1916. A brief resume of this report is given for comparison with the second case which will be described later.

CASE I. Male infant six weeks old as born entricose. The abdomen kept gradually growing larger and larger until the child was brought to the hospital for operative relief.

On palpating the abdominal fluctuation was elicited except to the extreme left where tympanic resonance was obtained. In the right flank an elongated nodular mass was felt. There were no other physical signs. The infant except for the enormously large abdomen seemed in perfect health.

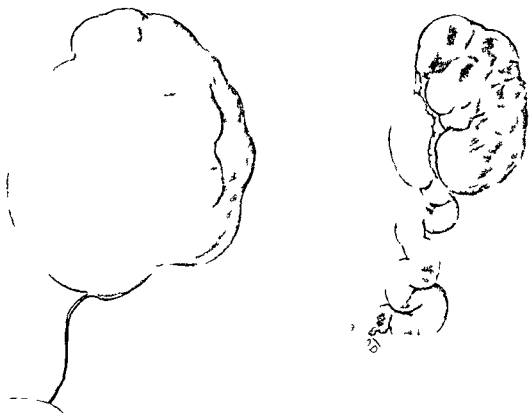
The X-ray examination corroborated the tentative diagnosis of a retroperitoneal fluctuating mass connected with the kidney. The presence of a positive liquid thrill obtained by tapping the abdomen with the fingers together through the histri from birth of a rapidly progressive cell in fluid insensibility point rather to a non malignant cystic tumor. We felt ourselves justified in making a diagnosis of congenital hydronephrosis especially as this was confirmed by the X-ray plate and therefore believed surgical interference as indicated.

At operation through an anterior abdominal incision an enormously large sac was emptied of about 900 cubic centimeter of straw colored fluid and with the enlarged kidney was completely removed. The infant made an uninterrupted recovery after the transperitoneal nephrectomy and is perfectly well today.

At the time I presented the first case I mentioned the fact that not many cases of large congenital hydronephrosis in young infants have been recorded owing to the rarity of the condition. About a year later I was fortunate enough to have the opportunity of successfully operating upon another infant ten months old for a similar condition and in a similar manner namely through an anterior abdominal incision.

In this case however the stricture causing the hydro ureteronephrosis was found not at the upper portion of the ureter but low down in the

Thrombolytic therapy for the kidney fistula



dia nosis of large congenital hydronephrosis can readily be made in the presence of a large abdominal tumor the etiological factor can only be ascertained at operation or autopsy.

The technique for removal of these large kidneys by transperitoneal incision is quite simple and requires little comment. The abdomen is opened through the rectus or by a pararectus incision. The intestines are held to one side by a large pack thereby giving a good exposure. The posterior fold of the ascending or descending mesocolon is incised and through the rent the kidney is easily delivered from its bed and the ureter traced down to its insertion into the bladder. The vessels and ureter are doubly clamped and tied separately. After removal the incision in the mesocolon is closed with continuous catgut sutures and the abdomen closed without a drain.

The present day operation of nephrectomy is done through a lumbar incision. While this is wise in the majority of cases it seems to me in infants subject to large tumors of the kidney a transperitoneal incision through the anterior abdominal route offers better facilities is more practical and advantageous on account of the better exposure gained thereby besides it is safe because strange to say infants bear laparotomies very well.

The general tendency has been to remove kidney tumors by the lumbar incision. This method is based upon the consideration of keeping clear of the peritoneal cavity. This no doubt is a weighty consideration. However to remove the large growths through a lumbar incision in infants especially where the costo iliac space is so small offers great difficulties and to me seems very hazardous indeed.

It has been my experience that infants withstand abdominal operations remarkably well. They stand handling of the bowels with few bad results but they do not stand resection. This is well exemplified in laparotomies for intussusception where in reduction of the intussusception a great deal of manipulation of the bowel is necessary. With careful sepsis peritonitis can almost always be prevented. A further advantage in the anterior route in young infants is that the presence of another kidney is most assuredly ascertained.

SUMMARY

Taking into consideration the above statements and the experience gained from my cases it seems to me the dangers of the transperitoneal route are inconsiderable in proportion to its advantages.

A NEW FRACTURE-ORTHOPEDIC OPERATING TABLE

By FRANK H. ALBEL, M.D., Sc.D., I.A.C.S., NEW YORK.

M J M R C U S A P f d d e c t f d p t m t f o t h p d s g r y N w Y k P t G d t M d I S h o o l d H p t l

HISTORICAL

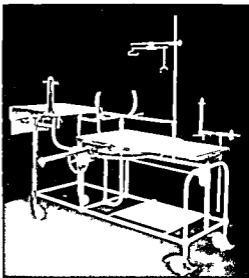
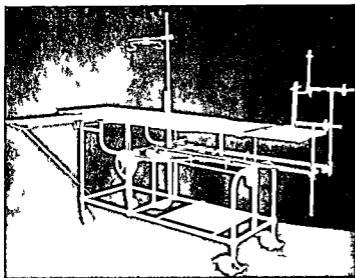
THE necessity for some external means of traction and leverage in the treatment of fractures and deformities of acquired and congenital origin is exemplified by the time honored use of weights, screw devices, sand bags, pulleys, etc. More exact mechanical methods are of comparatively recent origin and appear to have been devised primarily as aids to the reduction of congenital dislocation of the hip.

Heusner (1) in 1897 described an extension table but its use necessitated manual fixation of the pelvis. Schede (2) in 1898 devised a table which permitted extension in one plane but like Heusner's it did not provide for fixation of the pelvis. In 1903, Heusner modified his original table combining the traction feature of Schede's

table with the addition of a trochanteric grip (resembling the *Huestiguerth* employed by Lange) as an ambulatory splint in unreduced dislocation of the hip. Ridlon of Chicago and Hibbs of New York have both devised tables which are a decided improvement upon those just mentioned.

Lemon (3) was probably the first to present to the profession an apparatus designed primarily for the production of extension. In 1907 Lemon described a fracture apparatus the purpose of which was to enable the surgeon to reduce a fracture of any of the long bones of the lower extremity and hold the fractured ends in apposition while the plaster of Paris cast hardened. The apparatus was designed to be attached to an ordinary operating table.

The essential features of Lemon's apparatus



The table is attached to the main frame of the apparatus by a universal joint mechanism. The table is supported by one end of the main frame and the other end of the table is attached to the main frame by a universal joint mechanism. The table is supported by one end of the main frame and the other end of the table is attached to the main frame by a universal joint mechanism.

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Sauerbruch and Litzmann (4) in 1914 designed a table primarily to facilitate the reduction of certain dislocations of the hip but which could also be used in treating operations and in fracture treatment in general for the apparatus is the instrument.

Hawley (5) in April, 1915, presented before the New York Academy of Medicine a table designed to provide for the support and immobilization of the extremities and trunk with or without lifting the patient in any way and to afford reliable support and traction of the lower limb in the treatment of fracture.

Hawley's table has a flat top in the center of which is a hip rest set practically flush with the center of the table. The top is made in two sections a smaller one to support the head and chest and a larger one resting on four casters which act as levers so that it can be lowered leaving the smaller section and the hip rest projecting. Hanging downward from the top of the table is a lever which automatically locks the top when it is up. The top is locked and raised by a handle. Each part is fitted with two perpendicular short and a longer one with winches for movement which a line can be hung to support the knee or thigh and prevent motion. The side of the table frame is attached by extension bars which can be placed at any angle of abduction (Lemon). On the other side foot pieces which the foot can be bandaged and traction applied. Much credit is due Lemon and Hawley for this table many features of which have been copied in our table.

CENTRAL CONSIDERATION

One of the large problems of modern warfare is the treatment of infected compound fracture. The fracture is very unlike the compound fracture encountered in civil practice the sound

are extensive and infected the bones shattered and the problem is complicated by the presence of bullets shell fragments or pieces of clothing Plaster of Paris splints with extensive bridges or windows applied in the ordinary limb positions have been used in these cases in the past but their employment as pure coaptation splints has now been largely abandoned because of the extensive complicating wounds and the necessity of wide exposure thus interfering seriously with the control of the fragments which are being displaced by muscle pull

The fracture-orthopedic operating table finds its chief field of usefulness in accomplishing at the operating table that which the Balkan frame or other allied apparatus does at the bedside With it the surgeon in the operating room can obtain the same degree of position of neutral muscle pull immobilization fixation and various mechanical postures which he can secure at the bedside by traction with the above mentioned apparatus In this connection reference should be made to the publications of Dr Joseph Blake (6) on this subject

In order to obtain the same results it is necessary to employ a fracture orthopedic table possessing a wide range of adaptability i.e. all the various positions of neutral muscle pull so essential to the successful treatment of fractures and readily attainable at the bedside by the above methods can be secured in the operating room only by a table which will not alone permit traction in any desired direction upon either the upper or the lower extremities but will also hold the affected part so fixed during the application of the plaster of Paris dressing that neither the traction nor the position of neutral muscle pull on the one hand nor the alignment of fragments on the other will be deranged

Such requirements have not been fully and successfully met by any traction table yet on the market The chief deficiencies of such tables have been (1) Length and weight of table (2) The difficulty in moving the table about due to the absence of swivel trucks (3) Projecting traction arms and other attachments preventing use as a general operating table (4) Limitations as to adjustments which would permit important positions of neutral muscle pull and other indicated postures of the extremities (5) The axis of the traction arm has always been placed at the center of the table which is far internal to the axis of abduction adduction of the hip joint This is a most serious objection the axis of the traction should be made adjustable to variations of width of different pelvis in every instance the axis of

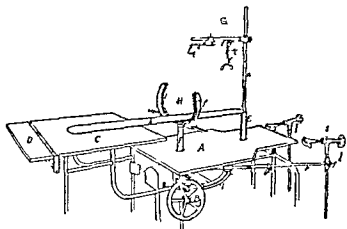


Fig 3 The principal attachments of the fracture orthopedic operating table are A Movable part of table top B wheel to raise and lower C Stationary part of table top D Drop shelf E Post forearm suspension apparatus F Hip rest post G Arm suspension apparatus a bar for vertical adjustment b suspension bar c carrier d and d' sliding cross pieces adjustable to individual forearm e and e' hooks for traction bandages f hand rest for counter pressure g screw for fixing height of b thus allowing for graduated traction H Body holder for application of shoulder spica h rest iron i cross bar j j' axillary holds k metal board back rest easily removable after application of shoulder spica l traction and abduction apparatus l' grooved quadrant for control of abduction adduction of traction arm m set screw to hold tractor arm n telescopic traction rod recipient tube o set screw p distal half of traction rod q set screw r sliding rod for foot support which allows graduated adjustment of flexion and extension s screw for fine adjustment of traction (for details see Fig 6)

the arm has been in the center of the table far internal to the actual axis of the hip joint the result being that in attempting to abduct or adduct the limb the amount of traction is never the same for the axis of the limb is eccentric under these conditions the movement of the traction arm into further abduction markedly diminishes traction (6) The lack of gradations in elevating or depressing the lower half of the table is a distinct deficiency it has been necessary in all tables either to completely raise or lower this section (7) Raising the depressed end of a fragment by former methods could be secured only by overhead methods which were an encumbrance to the operator

Each of the above objections has been overcome by the writer in the *fracture orthopedic operating table* which he has devised and which is herewith described

GENERAL DESCRIPTION

The table is comparatively light in weight Its top is constructed of Monell metal which is non corrosive and non oxidizable The frame is made of brazed tubular material to afford the



Fig 4

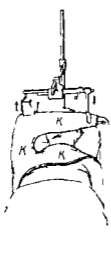


Fig 5

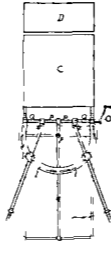


Fig 6

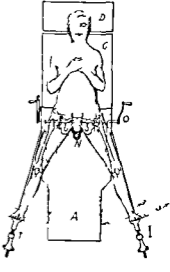


Fig 7

Fig 4 B d v f p t u t f d th t t l in
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b y d t u t t t j t h y c a b e c d l y d t l d
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Fig 5 W t h d f i n t b l t p d c e t r t d
t m m b h z t l m b y p l t f P n h l d p
A t h t l e t d p o t (n t l m s e l p l l)
f p p h y l d g i c l k f t f t h p p e d
f t h h m W t h t t h x d b y t h h d t
f f l c m t t m t a i n d i t h d t n f
t h b b d g J p s e d t h h k t l l y
c p e d d b e a t h p u m a l e d f t h f e a m
O t h l t t F
l o s d j m t t f p m a l d s f t t
m a m h c a l d f h u t i n g t h c t f t
u f t h t t m t p u n t c r r p d g t
g t l t h t t l b t t h h i p j t f

th d d l Th k O t r the b a P t h h i e s
f h h h a r m t h d u t p p o t d t
T n t h k m t h d Q d Q m l t
l y k p t h m l y q u d t t f m t h t e
f t h t b l e Th p t f t h m d t h s
m d t t l l n g l f m t d t t p e
t l y b l s the b d t n d d t o f t h m
t d s c b e t h i c l t h c h p t
Th t t u m b f d u p t h q d t f f
v h p t b y t h e s t O t h l t t
l 3
I p I t u l p p l t u f l g t u s h g
m b m f t h s d j m t f t h p u m l d
f t h t t m l l t d F g 6 T c t u m d
b y t h m s l d f g t c o t t u t d b y
t h p n l p o t v Th x f o t t f t h p u e t
l g n b d t h t t a t d d t h f t d
c b t h c f l I f t h s f t t f t h
t a t m d t h t h t h h a g t h
m t f t c t u f m b d t n g d d t g t h l m b
I f h t h t e f t t t f t h t t a t
j 3 b d t a t h f t t d b e t h m o f
l 3 d t h m t f t t u s e d I f t h
t t b d t c a s t h f t t d b t h
f l a d t h g t d m t n t h m t
f t a t I f m t t t b l t h t m
m e t f t h t t n o d g d l y f d t p o t

lightest and strongest structure possible All four wheels are swiveled the two at the foot end being furnished with foot locks to fix the table and prevent it from rolling When folded up this table is as short as the usual general operating tables and because of this and the fact that there are no parts projecting when it is not being used for traction it is of use for general surgery and is particularly valuable in general military work The traction tables heretofore in use have not been of practical use as general operating tables

Details The tucks of the table rest on swivel rollers permitting it to be moved about easily while a locking apparatus (Figs 1 and 2) over the two at the lower end operated by the foot permits it to be easily fixed in the desired place The ability to move the table about easily is of the greatest convenience in that at any time during the operation the table can be so moved that better light is secured in the depth of the wound or one's clinical observer can be afforded a better view of the operative procedure The tables previously manufactured do not possess

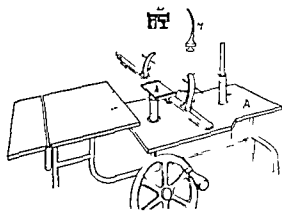


Fig 8

Fig 8 Cross section of body holding device in detail
L Cross section through *h* M profile of *j* other letters as in Fig 3

Fig 9 Details of the distal portion of the traction arm and the foot hold (*l m n o p q* and *r* as in Fig 3)
s Grip of screw for fine adjustment of traction *t* collar to prevent draping sheets from becoming jammed in threads of screw *u* adjusting screws *v* box for foot bar and heel rest *x* sliding heel rest *y* which slides back to release foot and plaster splint from table *z* broad flat steel foot bar which after cutting bandages is withdrawn from slot in traction arm thus freeing completely patient's foot from table

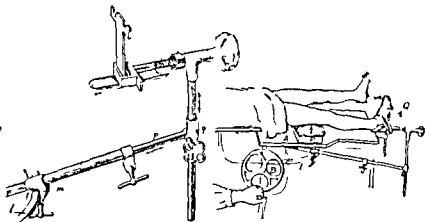


Fig 9

Fig 10

body shown in Fig 7 Foot bandaged by *Q* to the foot bar the bandage passing over projection *x* of the foot bar The leg is swung into the desired degree of abduction and fixed by turning set screw *m* Gross traction is made by elongating *p* and fixed by tightening *o* Flexion is secured by elongating *r* and fixed by tightening *q* Greater traction is secured by turning grip of screw *s* Lower half of table *A* is lowered by turning *B* To overcome posterior displacement of a short lower fragment of the femur a pillow or block and sandbag *P* may be placed under the offending fragment and the table again elevated levering the fragment into place while the internal fixation agent is applied whether it be an inlay bone graft kangaroo suture wire or Lane plate

Fig 10 Practical application of traction Position of

the locking apparatus and the wheels at the foot are not swiveled

A sliding leaf (Fig 1) at the foot and a hinged leaf at the head allow the table to be lengthened as much as necessary while a removable shelf (Fig 1) steadied by a rest can be used for instruments or to support the arm or leg of the patient

The long traction arms are telescoped and therefore allow sufficient shortening so that they can be swung under and out of the way when the table is being used for general purposes and traction is not required

Hip rests of two sizes are furnished

The head of the table is movable up and down from the hip rest similar to the Hawley table, so as to allow the application of various widths of spicas

The foot end of the table is capable of being elevated or depressed to any desired height by means of a wheel with handle *B* This ability to raise or lower the foot end of the table by graduated adjustment is an important innovation in that it allows sand bags or pillows to be placed beneath the sagging ends of fracture fragments to elevate these fragments in the proper alignment readily accomplished by a few turns of the wheel the handle of which is accessible to the surgeon by whom it may be grasped under a

sterile towel so that at any time during the operation the surgeon has the mechanism of the table under his complete control If the surgeon is dealing with a hip case he is enabled by depressing this portion of the table and inserting a sand bag under one buttock to have complete control of the upward rotation of the patient's hip or pelvis in any degree desired both before and during the operation

Lengthening of the traction arm is accomplished by two adjustments Coarse adjustment is attained by graduated telescoping of the arm and a more powerful fine adjustment accomplished by means of a screw This screw differs from those of previously constructed tables in two respects First it feeds as well distally as proximally when the wheel is turned Failure of this back feed has proved a great annoyance in other traction tables which the writer has used Second the screw threads are covered by a metal cuff which prevents jamming of sheets or towels into the threads while traction is being made

The foot is held in position by a muslin bandage placed over it and including in its folds the movable flat bar placed against the plantar surface of the foot and the curved plate beneath the heel These flat bars (foot plates) are very

stron being made of solid steel in certain other traction tables the foot plate bend. These plates fit into the distal extremities of the traction rods at which point the small sliding curved plate prevents compression of the heel and obviates dropping down of the foot due to the obliquity of its dorsal aspect where the bandages encircle it during the application of a large amount of traction. This sliding plate prevents the foot from kidding downward away from the foot piece an accident which commonly occur with certain other traction table. After plaster of Paris dressing have been applied and the restraining mu lin bandage cut both of the e sliding plates are removed thus freeing the patient's limb from the traction arm without disturbing the plaster.

Screw adjustment of pelvic ends of traction arms (see Fig. 160). The proximal end of the traction arms are universally adjustable by means of a heavy screw placed crossway to the table. The screw bar is placed to correspond with the horizontal plane of the hip joint slightly above the perineal point (the horizontal plane of the symphysis pubis). The distance apart of the perineal point and the screw bar the traction arms represent an average of comparative measurement of various pelvis.

The direction of the thrust of this screw bar are reversed on the opposite side of the center so that when the attached crank is turned the ends of the traction bar uniformly converge upon or diverge from the center of the table. This enables the union to make his adjustments in accordance with the width of pelvis of each individual case so that traction remains constant throughout abduction or adduction which is usually desired. However by placing the axes of the traction arm farther apart the amount of traction may be increased as abduction is increased the opposite result is secured when the axes are placed nearer the center. In the management of hip lesions and fractures near the hip the former may be an important and valuable adjustment.

Counter traction is applied as in most other tables by means of a *perineal traction post*.

Traction in the upper extremity. In the year 1908 the writer (7) first described the anterior elevated position as the position of neutral muscle pull for controlling epiphyseal and surgical neck fractures of the upper end of the humerus. No operative fracture table has heretofore been devised which enables this position and traction to be maintained both during the operation and the application of the plaster of Paris cast. This is an important feature of the table

herein described. With the foot end of the table fully depressed a rest iron Fig. 3 *h* is placed upon the hip-rest post with the cross bar inserted. The thin metal board back rest *k* is placed on this iron and the head portion of the table. The patient is then placed with back and occiput resting on this board with the shoulders in the region of the cross bar. The post with arm suspension apparatus *G* is put in the post at the foot end of the table with the arm traction bar properly adjusted to the individual case the elbow flexed to a right angle and the wrist placed beneath the hand rest *f*. Traction is then applied to the humerus by means of gauze or mu lin bandages passed beneath the upper end of the forearm near the elbow joint and over the hook *e* in the cross bar of the arm suspension apparatus above. The axillary holds *j* are then placed on the cross bar *i* and adjusted in place. For counter traction the weight of the patient is usually sufficient if not it can always be adequately secured afforded by bandaging the shoulders to the cross bar which carries the axillary holds. The patient is thus firmly held with traction in the ideal position of neutral muscle pull not only during operative fixation of the fracture fragments but the position and the traction remain undisturbed during the application of the plaster spica precisely as in the application of the hip spica.

To release the patient from the table after the application of the shoulder spica it is necessary only to cut the bandages external to the plaster, disengage the wrist rest, pull out the cross bar and axillary holds, elevate the patient's shoulder and remove the back rest board. If it is desirable to fix the arm in the abducted lateral position traction and fixation may be secured by abduction, the leg traction arms to a right angle with the long axis of the table and applying traction by strap above the wrists in precisely the same manner as in traction upon the lower extremity. In the case of fracture of the forearm or in the region of the elbow adhesive stickers may be applied to the point of fracture left in place and covered by the plaster dressing or a carefully applied wrist let may be employed.

USES

1. It may be used for the reduction by the closed or open method of fracture of the extremities particularly about the hip or upper third of the femur. The maintenance of traction and the limb posture (as neutral muscle pull) during the application of the fixation dressing viz the anterior elevated position of the upper arm in the

case of fracture of the upper end of the humerus (position of neutral muscle pull) or the abduction flexion position (neutral muscle pull) of the thigh in fractures just below the lesser trochanter. Many other such mechanical postures could be enumerated but lack of space forbids.

The table is of great use in the mechanical fixation position of abduction (Whitman) in fractures of the femoral neck.

During traction lateral displacement of fragments can be corrected by direct pressure. The rough edges and serrations in oblique or transverse fresh fractures can be utilized under the influence of traction to interlock the fragments and maintain reduction.

The importance of full surgical anesthesia is timely in the case of all fractures in order to obtain complete muscular relaxation.

In compound comminuted gunshot fractures where the necessity of limb posture is doubly indicated on account of the inability to make the most of coaptation splints because of the loss of large amounts of soft tissue.

3 The reduction of dislocations (traumatic or congenital) and the maintenance of limb posture during the application of fixation dressings.

4 The application of plaster of Paris fixation dressings in the treatment of joint diseases etc.

5 Joint resection osteotomy osteoplasty, etc.

6 Application of plaster of Paris jackets.

In closing, it may be remarked that many of the latest books on fractures make no mention of traction operating tables or the advantages of them. In other words, an indispensable general method of fracture control is entirely overlooked by those most competent to advocate its use.

The author wishes to thank Mr. C. P. Tolman consulting engineer of the National Lead Company for making helpful suggestions concerning the mechanical features of certain parts of the table. Mr. Harvey R. Pierce of Philadelphia for his valuable aid and to Tascarella Brothers for their hearty co-operation in the perfection of the table.

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RUBBER TUBE RECONSTRUCTION OF THE COMMON BILE-DUCT

SULLIVAN'S METHOD¹

By FREDERIC HAGLER M.D. St. Louis

THE various problems of bile duct reconstruction and repair have been discussed in several recent papers. Study of the question has been much stimulated since Jacobson's excellent article of three years ago in which he collected more than 30 operated cases. Brewer, Mann and Sullivan together with a few foreign surgeons had then performed a total of 2 reconstructions by the rubber tube method which Sullivan experimentally devised. Variations and improvements have been offered the most valuable being the use of the T tube as employed by Mayo and the Walton operation with its modification suggested by Ginsburg and Speese. Lengthy discussion of the subject or its literature is scarcely justifiable at this time but we deem the following case as worthy of a detailed report.

Mrs. A. R., age 38, housewife, was admitted to the St. Louis City Hospital on October 6, 1915. The patient was the mother of six healthy children and except for an appendectomy seven years before and two induced abortions in early married life she gave no history of past illnesses. The illness for which the patient sought relief began acutely ten days before her admission, being ushered in with colic like pains in the gall bladder area radiating at times to the back and the right shoulder. The patient had vomited much during the first three days of her illness and had suffered excruciating pain during the frequent recurrences of the attacks. Jaundice was noticed by the patient five days after the onset of the illness, which time marked the cessation of the colic. She complained upon admission of soreness in her upper abdomen and distress upon taking food.

Examination revealed a poorly nourished white woman of medium stature. The mucous surfaces were pale, skin and sclerae markedly icteric, the tongue heavily coated with brownish fœtids. Chest examination was negative. The abdomen was generally slightly rigid with marked tenderness

th p g str m d p tucula ly i the gall bladd
 a T m j r t oo6 pul oo Th l u t y were
 t mat d t oo Th g p u t t f bile
 Th tool t l h h c \ y m n t f g ll
 t t l d p t t t t m t t h j
 di p dly dis pp d d th t mpe atw e d p l
 ma d m l Th p t t mpla d b t l y ho
 f g l l b l d d g n d y er
 p g t i i p u g Operat n d d to
 h h i t t g r d
 Op f O t b 8 9 5 Th p t eal ca ty
 f d th gh h gh t l lightly to
 th b t f th midlin Th m t m t m h d d d
 m f d d ly dl t t t h d f f
 th h m p l t ly b c the g l l b l d d e In
 p t g the dh a t h c p u l g e y
 l t g b t t c p u l l y h a m r h a g D s e
 t f th dh d f f i t b e a s e f t h m b d d e t y
 f th dh b t t g l l b l d d d h b l d c t
 th f l l y d t f d N t p t t the un
 th l l b l d d th b l d t Ch l y t t m y a f
 d d d p o b f t h h g h l y d d d t t m y a f
 th g l l b l d d d t h d b y f g t h f p t
 f t h b l d d t g t h d t d g l l p t
 g t h d l y dh t l p t f t h g l l l d d
 f m t h d d m t f d t h t l g m m
 t t d b t t h t d d t h t l t l f t
 l g p e g t h t d o d m l g l l b l d d
 Aft h l t t m v h d b m p l h d l
 t d l t t m t l g t h d t h t
 t l l f t h m m d t t p t m m d t l
 t d d d l t t Th h t t f l b l
 p b p a d p d t l t h p t d t j l o
 d n d t h g h t p p l t t h d l m K p
 f t h d d m d d d f l t b y t h f g l u y
 f t d b l l Th l m y m h t
 b y t h b l f t d t h t t l l
 a t h h t t l t t t m u g t g t
 t t m v h l y l f m d t l g M p h
 b t t l l b b e t b t d u p d t h r g h
 t t h t h m m d t d d t h t g u t
 t h Th d l s e d l y f t p d i g i
 d a g b y m f t l g g t t d

Operative injury to the bile ducts has been reported with sufficient frequency to dilution the one who reared cholecystectomy as a simple operation. We are of the opinion that such injury is frequently unrecognized and that it is reported much less frequently than recognized. The injury occurred in this instance at the hands of a skillful and careful operator who sought to minimize danger of injury to the common duct by freeing the gall bladder from the tip downward instead of proceeding upward from the duct. The injury was however not extensive and had it not occurred the duct should have been incised. We consider incision and exploration of the common duct necessary in such cases in order to establish the freedom of the bile passage from stricture or stone. Drainage of the common duct for a few days is likewise desirable. It is to be emphasized that the operative injury in this case did not produce loss in continuity of the common duct.

The spontaneous cholecystenterostomy which necessitated repair of the duodenum after the gall bladder had been removed was to be viewed as a much more serious complication for the condition was analogous to that produced in transduodenal operations which are not infrequently necessary and in which the fear of duodenal leakage always arises. The gastroenterostomy we now believe to have been a life saving procedure and one to be more frequently made use of in duodenal repair incident to transduodenal operation or duodenal injury.

The postoperative course was as follows:

V o u h y p o d m u t m l a t i n e y d u r n g
 the h t f h R y i m a t h s l
 a d t h g e l d t p m f l d y
 B g n n a m m d t l y f t p t a t h d h a r g
 f b l b t h t h r g h t t b d t t h d d h a r g
 r y p f Th u d b c a m e n f c t d d d e l
 m h p s O t h f t h p o s t o p e t d y d l n a l
 t t l m a n i t d t s l f s e t t p m u h d d u t
 d k i t A t t h j t e d g f b i l e
 th g h t t b d t t t l b i l y r y t t
 g t h t h d d l t t b g d i s l g d l f d e
 th t b t t h d g t a f b i l p p e d
 th tool Th t b e t h d n f m t h m m
 d t t h t h d y t h t h h o l d i g t l d n d
 p m u t t d t h d l Th t h d m l l u
 p l Th p u t n h d b m f l s e
 s o l t p e t m p p l m d b y t n e t m a
 n l m l l q t t f f l d b g d m u t d b y
 m t h R m k b i t l t t h d o d l f t l p o
 t l y e d d h g g the i n t h d y d t h e
 d t t d t g m h t c t b e g a t h a l
 C l s e f m t h u p o t m e s a t i f c t r y p
 m u t t g m l f t h d the f i t t h d y The
 p t t s a t t f b e d t h t h r t h d a y a d t h M
 p h y b t t d f m t h t o l o t h e t h t y
 n t h d y Th h k d m a d t h p t t
 f f m d i s m f t Aft t h o p e t n t h h b t t
 t f b l t p e d the t l h u l h y
 d r g s a t t d t d l y w t h g n h y l l
 t b g h y l l w b l

The development of the duodenal fistula occasioned much alarm for unless repaired by a second operation this complication terminates quite regularly in death. The extremely grave condition of the patient deterred us from operative interference and for a time no hope were entertained for her recovery. The spontaneous healing was in our experience altogether unique. It was possible we believe only because there was complete diversion of the bile from the duodenum through drainage of the common duct and diversion of stomach contents through gastroenterostomy. The complete permanent biliary fistula we considered to result from obstruction (most likely by adhesions) of the common duct below the opening through which the drain had been inserted. In this premise we were proved mis-

Operation. January 13, 1916 by the author. Incision was made slightly median to the old scar and fistulous opening. Numerous adhesions between omentum stomach liver and duodenum were divided by careful blunt dissection. The biliary fistula was found to result from a complete loss in continuity of the common duct the defect being about 2 centimeters long involving that portion immediately above the duodenum. The stump of the duct above the gap was firmly imbedded in dense adhesions but the lumen was of normal size and a probe was easily passed upward into both hepatic ducts. Clear bile flowed slowly during the operation. A lower stump or remnant communicating with the duodenum could not be identified. The duodenum was firmly fixed by adhesions the wall was thickened and friable the lumen very small. The pyloric end of the stomach was likewise fixed by adhesions and contracted. The gastro-enterostomy opening was patent. A hasty consideration of operative possibilities led to the following procedure:

A piece of fairly stiff rubber catheter size 17 F. about 7 inches long was used as a tube. One end of this was passed upward into the lumen of the hepatic duct as far as the bifurcation and fixed in place with chromic catgut sutures. An opening was then made in the duodenum just sufficiently large to permit of passing the remainder of the tube (about 4 inches) into the lumen. The tube was anchored to the edges of the opening with chromic catgut sutures but no attempt was made at valve formation by inversion sutures because the friable duodenal wall did not hold the sutures well. An artificial duct was then constructed by enclosing the centimeters of exposed tube with omentum utilizing also adventitious tissue which had made up adhesions. This omental casing was stitched above to the hepatic duct and below to the duodenum. Two rubber dam drains were inserted and the wound was closed in layers. The patient was in fair condition at the close of the operation.

This second operation showed a complete absence of at least 2 centimeters of the bile duct which certainly was not removed at the first operation. The loss was undoubtedly due to a necrosis provoked by one or a combination of the following factors: (1) operative trauma (2) pressure (from drain) (3) infection, (4) digestive action of duodenal secretion.

The last two we consider to be of most importance. The abdominal wound showed much necrosis, due to infection and the irritation of the duodenal fluid. The first two factors could be excluded in the case of the abdominal wound and our presumption is that the necrosis in the depths was quite analogous and produced by the same causes. Brewer felt that infection and digestion were responsible for sloughing and loss in continuity of the common duct in one of his cases. The question arises here as to whether the duodenal leakage might not have occurred from the site of opening of the necrotic common duct instead of along the suture line.

The method of reconstruction was adopted according to the exigencies of the case. On account of the firm fixation of the duct and duodenum a direct implantation of the duct stump

into the duodenum or jejunum was impossible. The condition of the duodenal wall prevented employment of Walton's operation or its modification a circumstance which may frequently occur in this type of secondary operation. The various plastic operations such as fascial transplantation the use of gall bladder appendix etc. were all unadapted because of the condition of the duodenum and duct. Furthermore the appendix and gall bladder were both absent in this case. The choice between the use of the Mayo T tube and the operation of Sullivan was not so lightly determined. It seemed to us a definite advantage to use a method which would restore the duct in its entirety and not again leave a defect when the T tube was removed. A further disadvantage in the use of the T tube is the tendency toward displacement with a resulting obstruction to the passage of bile. Ginsburg and Speese report a case instancing this objection.

That the immediate result left nothing to be desired is evidenced by the following:

Recovery from the anæsthetic was slightly prolonged. There was little discharge from wound and only upon the second day was there a trace of bile in the discharge. After the third day the dressings were dry. There was a *large brown stool* on the third day. The drains were removed on the sixth day while the sutures remained until the eighth day. The patient was out of bed on the twentieth day and was discharged from the hospital on the twenty-ninth day, gaining rapidly in weight and strength. The X ray showed the rubber tube still present in the duodenum upon patient's release from the hospital. She returned regularly for examination and at the end of the ninth week the X ray showed the tube to have passed from the bowel. The general condition of the patient at the end of the ninth week was excellent and she was again caring for her children and performing her household duties.

Our only fear at this point was that obstruction might develop as a result of cicatricial contraction of the newly formed duct. The patient was however entirely free from symptoms for over seven months when she again applied for hospital treatment. I am indebted to Dr. B. W. Kippel, resident surgeon of the St. Louis City Hospital for the further history of the case.

Mrs. A. R. was readmitted to the City Hospital August 10, 1916. The patient had enjoyed good health uninterrupted since operation until two days prior to her admission. The onset of her illness was very acute with chills and fever, general abdominal pains, vomiting and diarrhoea. The patient attributed her illness to eating a large portion of potted ham. Examination showed Temperature 98.6 pulse 108. General abdominal tenderness was present but no localized tenderness could be elicited. The abdominal scars were well healed. Leucocyte count was 9,600. The provisional diagnosis was ptomaine poisoning and eliminative treatment was instituted. There was apparent improvement until August 21, on which date the patient chilled repeatedly while the temperature rose to 101 and the leucocyte count to 17,400. The Widal reaction was

F s Th d t f p f i a l g u h t w o u d
 d l o c l a t h 56 f c a l d t l a
 f t r l g n a t n b y u c t i o w
 m t h l 5
 F t p h y f t h b l a d d 6 8
 F p e r m t l C l l a d t d s o n c g n a t a l p y l n
 t 3 8
 E p r i m t l p h y l m i c a l t f o a n a t c t s 96
 E t t n U r i r y 96

F A S C I A t a p l t t t o l t l d e f c t f t h e
 m j t r s 3 4
 F b r d t e l d m t h e t m t f e e t a t y p e s
 f t r e h a m h g e d 495
 F l d T l F h S r d S t e t h c r 354
 l l f r m t t f t h t h A m t h d o f t t
 g 34
 F o r t l d t h d n g l b 45
 F a t A m d n t f t h A h l l d m t h d f o r d
 t m t m t m t n t y f t h t 563
 t p M o d c d t r e d s c e t t h c a f l
 m p l a t f t 7
 F t T h t m t o f b y p e d t e n
 6 T h t m t f f t h t m t b y m e n f
 p e d t t 45 A r s a l f r a m
 m b g p n t l t c t f t h l r
 p p e t m t d f l p c t l p e l l y
 f l m l t r g v 339 A t f l u m p t u f
 p d y l d f t h m r u c h i l d t 474
 A t h p d p t s t b l 683
 F m A n l f a c t u m b i n g p e w t h
 t t f t h l e a d p e t m t y d f i o o r
 p t l e c l l y f l a m l i t r y n g y
 0
 F h S r d S t e n t h F l d 354
 F t G a t r i l l n g t t t m y a l y
 f 73 c 5

G A L L S T O N E d u T h h l e s t e l t t o f t h
 b l o d 8
 G a t f t f l l g g s t t e t m y a l y
 f 7 a 5
 G t r t t m y G t r c f u c t i f o l l a a l y
 s s f 3
 G l H f l l 3 B E F F S m e b a t s
 o n m l t r y g y d i n g 3
 G l a R y l M t t y d W m n H p t l E
 p e t h t h m m f 96 35
 G t g S u p l f d l
 G h t f t h l g p o t f 3 638
 w d I m m d t u g e r y f t h m n g
 46 n t e m t m p e f r m d t h f b r
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